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PRIZE ESSAY.

SOME IDEAS ABOUT ORGANIZATION ON BOARD SHIP.

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"Good organization is vital to efficiency;
Efficiency is vital to success."

FOREWORD.

This paper has for its aim the expression of certain ideas about navy personnel, particularly with regard to the organization on board ship. Many of the ideas are already making way in the service, others are talked of, some may be new; no claim to originality is made, as the subject-matter has been taken from many sources, to which acknowledgment is hereby made.

It is universally admitted that the service is in need of reform in the matter of organization, and this is as necessary on board ship as in any other connection. The methods of handling personnel now obtaining in the service are largely due to accretion, combined with the primary disadvantage that there has never been any logical system, founded on principles, on which to base anything. The result is that the navy personnel has no semblance of organization, other than what exists temporarily; in the matter of personnel the service leads a "hand-to-mouth" existence. It

must be conceded that this state of affairs has one advantage, for the personnel can be adjusted to any situation or requirements whatsoever; its lack of system forces on it the qualities of elasticity and adaptability to a degree.

The writer fully realizes the possible opposition, for if there is anything more characteristic of the navy than its fighting ability, it is its inertia to change, or conservatism, or the clinging to things that are old because they are old. It must be admitted that this characteristic has been in many things a safeguard; it is also true that in quite as many it has been a drag to progress.

The purpose of this paper will have been accomplished if discussion lead to the adoption of *system* in organization, whether existing conditions be better worked out, a better plan be forthcoming, or the ideas herein expressed meet with approval.

PART I. INTRODUCTORY.

PRINCIPLES OF ORGANIZATION.

Organization and administration are the means employed to control and direct personnel. *Organization* is the systematic arrangement of personnel for the accomplishment of any desired end; it includes arrangements for *administration*, which may be said to be the practice of which organization is the theory.

Such systematic arrangement must obtain in any body of men which is to be considered as other than a mere mob. Organization implies that every man's work is defined, that he knows exactly what he has to answer for and to whom, and that his authority is co-extensive with his responsibility.

The entire theory of organization and administration rests upon the principle of "*division of labor*," as embodied in two fundamental principles:

1. Division of personnel into groups under leaders, and
2. Definition of individual responsibility, authority, and subordination;

so that, no matter how great or how small the number of individuals gathered together, there is facility of control and direction, and some *one* is responsible, to which *one* the others must be subordinate.

Division into Groups under Leaders.—The proper control and direction of an organized force requires that it be divided into groups small enough to be kept in close touch with their immediate leaders. These smallest groups are combined into larger

groups, and these again into still larger groups, each group under its own special leader; steps are thus formed, so to speak, by which the will of the leader of all controls and directs the least individual of the smallest group. It is, of course, axiomatic that the division into groups shall be as simple as possible, based on the characteristics of the primary employment, and that the groups shall be under their own leaders in all that they do, so far as is practicable.

There is a limit, quickly reached, to the size of group that can be *directly* controlled by one man. This group is of such characteristics that it may be called the *base-group*. The number of men composing it varies in different organizations, according to the general needs of their respective employments, but experience has shown that this number is about one hundred and is continually growing smaller as specialization progresses. In any case the *base-group* should not exceed that number of men which one leader can *personally* oversee in their employment, influence by his example, and supervise in their instruction.

Within the base-group such subdivision into smaller groups takes place as may be necessary to the character of the principal duties to be performed; the subdivision should be so arranged that, in general, any and all forms of work may be performed by the assignment of the subgroups as units.

It is apparent that groups and their respective leaders must be graded in accordance with the size and importance and other characteristics of the groups themselves. Groups are usually given distinctive names, and their leaders are known by distinctive titles. In business organizations group-leaders are called superintendents, managers, foremen, etc; in military organizations they are called *officers* and are of three general classes:

1. Under-officers in base-groups.
2. Commanding officers of base-groups.
3. Commanding officers of larger groups.

The smallest groups are composed of men. There is a fourth class of officers whose duties are of such character that they may be called *specialists,* and they compose the *staff* of an organization. They act solely in an advisory or administrative capacity and may be employed on such duty either permanently or temporarily.

Definition of Responsibility and Authority.—In the most efficient organizations every officer above the grade of "leader of base-group" deals with a body composed of groups, with whose

interior affairs he does not interfere, save in the case of failure on the part of the group-leader concerned. The superior prescribes the end to be attained; the subordinate is left free to exercise his ability in attaining that end and is held to a rigid accountability for the performances of his own particular group. The superior inspects and tests the condition and efficiency of the several groups of which his own group is composed; the subordinates must have their groups prepared for such tests and inspections; if any group has not been properly instructed or is not in other ways fit to do its work, either alone or when acting in conjunction with other groups, the leader of such group is responsible and must take the consequences; e. g., be replaced, lose his chance of promotion, etc.

By such methods every officer is, in his own sphere, accustomed to the exercise of authority, the use of his judgment and the application of his ability; he is being prepared for the higher grades while doing his part as an officer of the lower grades, for control and direction of the largest and smallest groups differ only in degree.

By such means are the labor and care of controlling and directing a large body of men reduced to practicable dimensions. The higher the grade of the officer, the more general becomes the supervision and the less the burden of detail; he is thus at liberty to concentrate his mind on those matters that properly require his attention—to the employment of *his* group alone and in conjunction with other groups, to the forming of plans, the framing of a policy, etc.

AIDS TO EFFICIENCY.

The aids to efficiency that can be employed in connection with organization and administration are four in number:

1. Permanence of association.
2. Utilization of the spirit of competition.
3. Esprit de corps.
4. Recognition of skill.

Permanence of association alone will do a great deal towards producing efficiency, in that the men become accustomed to one another; they come to know that the other fellow will be in the right place at the right time and that he will do his part without fault or hesitation. It is through permanence of association that esprit de corps almost always makes its appearance.

The greatest efficiency is to be acquired only when the interest of the personnel is keenly excited and continuously maintained; the greatest single factor in this connection is *ultilization of the spirit of competition.* This spirit is inherent in man, and much can be done by its aid in getting men, even when green, to work efficiently; the desire to excel will cause men to exert every effort to prove their superiority.

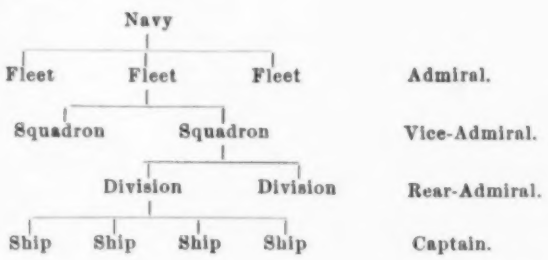
Esprit de corps is the most valuable and the most lasting of the aids to efficiency. It is to be noted that when men have this spirit it is usually the result of permanence of association combined with prowess gained in competition. So powerful is esprit de corps that it affects men when they themselves have done nothing of note, the prowess of their corps being handed down to them from those who have formerly filled its ranks. It is the best of all the aids to efficiency, for this "pride in the ability of the corps" is the highest incentive to good discipline, devotion to duty, and efficient performance of work under any and all circumstances; it is the direct appeal to honor.

If competition be employed to create or increase efficiency, there should follow, in order to get the fullest results, adequate *recognition of skill* to those groups which excel. This recognition may take the form of the awarding of prizes, the granting of privileges, or the mere publication of the facts.

PART II. THE NAVY AS IT IS.

THE GENERAL SITUATION.

If the question be asked, "Are the principles of organization and the aids to efficiency employed in the United States Navy?" the answer must be "Yes" and "No." Consider the following diagram, which shows the obvious "division into groups" and the corresponding "leaders":



It will be noted that the diagram stops with the *ship*, and it is with the *ship* that this paper is chiefly concerned. The *ship* varies in size and characteristics, but it is the one unvarying group-unit of command, of combat, and of organization and administration.

For group-units larger than the *ship* there exist standard methods of organization and administration, according to the principles already given; within the ship there are no such standard methods, and an attempt to diagram the organization on board our ships to-day leads to endless complication and hopeless confusion. It is impossible to say that the personnel of the ship is "divided into groups under leaders" after any uniform, definite plan, or that there is any "definition of responsibility and authority" that is exactly on similar lines on all ships. It is not to be expected that all ships are to be divided into the same number of groups, but there is every reason to expect that one system of "division into groups under leaders" obtain on all ships and that this division shall be based on the "principles of organization" and shall permit of the full use of the "aids to efficiency."

There should be but one "division into groups under leaders" and, as the "reason for existence" of a man-of-war is *action under way*, the arrangements for battle should be the primary consideration as the basis of all organization on board ship, for every possible purpose.

The present state of affairs is best made clear by a consideration of the conditions now generally existing; some of the conditions are good, more of them are bad, and there are no basic principles or underlying system to be found in the aggregate.

SOME EXISTING CONDITIONS.

The Executive Officer.—Under the navy regulations and the general practice, the executive officer's duties and responsibilities extend to multifarious details and requirements, a personal supervision of which is practically beyond the physical and mental capabilities of any one individual under the conditions imposed. He is expected to:

Carry out *all the details* in connection with the organization, police, inspection, exercise, and efficient condition of the crew, and the cleanliness, good order, efficiency, and neat and trim appearance of the ship.

Prepare for each member of the crew a billet which shall assign to him his rating, watch number, part of ship, mess, boat, berth, and station at quarters and at fire quarters.

Prepare *complete* watch, quarter, station, fire, coaling, and boat bills . . . . shall keep these bills complete and correct at all times during the cruise.

Inform himself of the physical capacity, service, record, and experience of *each man* detailed for the crew in order that he may station him to best advantage.

Be *responsible for* cleanliness and good condition of all compartments and double bottoms, and of all bulkheads, doors, valves, and pipes within them, except those specified as coming under the supervision of the senior engineer officer.

Arrange petty officers and enlisted men in one general mess divided into sub-messes of twenty . . . . detail messmen . . . . be responsible for the detail, organization, and discipline of the general mess, and for the condition of the mess gear and furniture.

Have charge of the preparation and keeping of all of the books, records, and returns required by the Bureau of Navigation concerning the crew.

Only the above instances are cited because it is believed that the greater part of this work can be well and efficiently performed by the officers commanding divisions, in accordance with the fundamental principles of "division of labor," thus freeing the executive officer of an unwieldy mass of detail while he, of course, retains full and proper supervision.

The Engineer Force.—Engineer divisions are assigned duties as a whole; and the senior engineer officer makes such disposition of officers and men as to watches, stations, and other duties as seems to him to be best; he is held responsible for the proper performance of all the duties assigned to the engineer force. This arrangement is practically universal and is the only situation that is in accordance with the principles of organization.

Authority of Officers Commanding Divisions.—Responsibility and the accompanying exercise of authority, ability, and judgment are indispensable factors in the education of an officer; our officers have too little opportunity in this direction while in the lower grades. They command their divisions only at certain times and under certain circumstances, in most of which they are expected to adhere to certain dispositions already made for them. At present the only opportunity afforded officers commanding gun-divisions to show their ability is at target-practice, and even this is an innovation of recent date. Lack of responsibility and the accompanying opportunities to exercise authority, ability, and judgment have often been cited as reasons for attaining command (of ship) rank at an earlier age than obtains in our service. Certainly officers should attain the rank necessary to command ships at an

earlier age; but, certainly also, an officer's career should be such that the requirements of the command of a ship should differ from the requirements of the command of a division in degree only. At present our system, if system it can be called, does not call for these requirements to the proper degree while an officer is in the lower grades; i. e., in command of a division.

Shifting of Personnel.—This is a practice which is gradually dying out, largely through the lessons learned in the development of gunnery, and "permanence of association" is being given a chance to exert its powerful aid in promoting efficiency. It has been clearly demonstrated that constant shifting of officers and men from ship to ship and from division to division cannot give good results, for permanence of association cannot be made use of and esprit de corps is not fostered. Happily, the day is well-nigh past when the ability of a man in keeping a part of the ship clean was allowed to outweigh his worth as a trained gun-servant.

Better all-around results in efficiency may be expected of the service in general when there can be inaugurated a system of reliefs for officers and men, so arranged that changes are as infrequent as possible. Even with such a system of reliefs there is but one effectual way to cope with the necessary changes in personnel; and that is—to have such a uniform system of organization and administration that what obtains on one ship is to be found on the next, so that all officers and men may know exactly what is expected of them under any and all circumstances throughout the service.

Ammunition Supply.—Under the rapid rate of firing possible at the present day the supply of ammunition *in action* is a most important problem; diligent exercise and study are necessary in order to develop the highest efficiency therein, the training of personnel being particularly necessary.

Rapidity and accuracy of *working the guns* is established; rapidity of fire is very great and has well-nigh reached the limit. However, in all except turret guns, rapidity of fire will usually be found to have a fictitious value, as its measurement is based on *time from rear of gun to muzzle*; the true measure of rapidity of fire is that used in connection with turret guns, where *rapidity of ammunition supply* is a determining factor. It is to be doubted if the ammunition supply of any of our ships is in such condition as to maintain an adequate supply at the gun. The true cause of

this state of affairs is believed to be the existence of a so-called powder-division on most of our ships, whose duty it is to supply ammunition to guns of the intermediate and secondary batteries, whereas turret officers are entrusted with their own arrangements for ammunition supply.

The Powder-Division.—The powder-division is a heterogeneous collection of individuals; it is not a division in the sense of being a group of men allied in work and associations; it is of proved handiness as a catch-all for the ratings which are so rapidly increasing on board ship. Its function has been to supply ammunition to the intermediate and secondary battery guns and, in general, to fill emergency-drill stations below decks. It is rarely exercised at other than general drills, and even at these full strength is not to be counted on. The control of the officer commanding the powder-division is necessarily nominal, as the division duties are scattered over wide limits, so wide that it is impossible for him to fulfil his proper functions as a "*leader of base-group.*" It is believed that the powder-division, as such, must pass away, its duties and functions being divided up among the gun-divisions; this for the following reasons: (a) that the idea of a division so constituted is fundamentally wrong, (b) that the best efficiency in prolonged action requires that the officers who command the guns shall organize and maintain the ammunition supply of their respective guns, (c) that in the all-big-gun ship continuance of the present-day powder-division in its functions would not employ the personnel thereof to best advantage, as they would be called on only to supply ammunition to the torpedo-defense battery, (d) that the officer commanding the powder-division cannot control, direct, and supervise the personnel of his division when the compartments below decks are isolated as they are in the employment of his command as a division, to say nothing of the difficulties in this connection that come with the introduction of the unpierced thwart-ships bulkhead, (e) that the most satisfactory organization yet applied to the powder-division is that in which it has been divided into ammunition-crews for the several guns or groups of guns and this crew-arrangement has been utilized in the assignment of the other stations and duties, and (f) that in connection with the foregoing, the ammunition-crews might as well have been a part of the gun-divisions they respectively supplied, and far better supervision and control would have obtained in emergency-drills as well as in ammunition supply.

Turret-Divisions.—Turret-divisions in general include their ammunition-crews, and the turret officer is in control from *magazine to muzzle*. This practice in regard to turrets is universal and uniform; it is believed that this is the proper and logical method of arranging all classes of guns and their respective ammunition supply. In any given case, intermediate or secondary gun-divisions could hardly be more cut off from their magazines and shell-rooms than are turrets in the system of handling-room isolation which has eventually been adopted—is it proposed to turn over turret ammunition supply to the powder-division on this account? It is to be observed in this connection that, in our later ships at least, the magazines and ammunition-hoists are so arranged that there is a hoist for each gun or each pair of guns or each group of guns. This being the case, there seem to be no adequate reasons why intermediate and secondary gun-divisions should not include their ammunition-crews and be in all respects on the same footing as turret-divisions.

Transfer of Crews.—The complement of any of our ships to-day is in such shape as to group-organization that if its transfer to any other ship or ships were to become necessary it would necessitate complete dispersion and subsequent re-organization. It is true that the crew might be transferred with its organization intact to a ship of its own immediate type, i. e., sister ship, and it might be possible to transfer some of the turret-divisions intact to other ships, but not so for the rest of the personnel, for a uniform system of dividing into groups does not exist.

Commissioning of Ships.—Under the present-day methods, or lack of them, the executive officer who is about to put a ship in commission is in for months of the hardest kind of work; consider what is expected of him according to navy regulations and the general practice; is it any wonder that it takes six months for a ship to "shake down" sufficiently to make it feasible for her to take her place in the fleet? In case of the sudden (or not sudden) outbreak of war, picture what would happen in the attempt to mobilize crews and make ready the ships in reserve, the ships newly completed, and those newly purchased—how long would it be before it was *safe* to send them into active service? In commissioning a ship under the prevailing methods, the executive officer receives on board what cannot be called other than a mere mob, for there is no organization; there are, to be sure, petty officers and men of

many ratings in more or less adequate numbers, and a certain number of officers of various grades, but there can be no organization, for organization of personnel does not exist in the navy outside of the individual ship; it is not even considered in regard to navy personnel as a whole. One of the first things the executive officer does is to turn over all the engineer force to the senior engineer officer with a memorandum as to the division duties of the engineer division; he is thankful that the general practice permits him to get that group out of the way; if anything goes wrong in that quarter he will look to the senior engineer officer to make it right. Does he continue this process? If not, why doesn't he? What could be more simple and more adequate than to issue memoranda to the officers commanding the gun-divisions and to say to them, "Here are your men; here are your guns, your boats, your part of the ship, division duties, division stations at emergency-drills: get busy; let me know as soon as your men are quartered and assigned tentative stations for fire quarters." How long would it take to get a ship's complement into working order if the executive officer dealt with the officers commanding gun-divisions as he does with the senior engineer officer? It is true that our executive officers and the officers commanding gun-divisions have not been educated to such methods; owing to mistaken ideas as to what constitutes command and control they have been brought up in a school of centralization, not only the centralization of the supreme authority but the *centralization of details.*

Watch-Duty vs. Division-Duty.—Up to a few years ago it was the practice to order officers to ships as "watch and division officers." The watch-duty was evidently considered paramount; and indeed it always must be the most important duty that an officer can be allowed to perform—*when* the ship is under way, and in certain circumstances when she is at anchor. However, it is certain that in many instances watch-duty is made to take precedence over division-duty in cases where the best interests of the ship would seem to indicate that the officers commanding the gun-divisions should have been replaced on watch in order to look after their divisions; this occurs chiefly in port.

The Deck-Division vs. the Gun-Division.—The division is, to a certain degree, the recognized "base-group" of organization on board ship, but there are nearly as many ideas of what constitutes a division as there are ships. Generally there are two sets

of divisions, sometimes there are more; an officer commands a certain gun-division, he may or may not command the accompanying deck-division; sometimes he is responsible for what his division does and sometimes he is not; it may be required of him on one ship, and on the next he may be censured for his supposed attempt to take away from the executive officer one of the latter's prerogatives as to the control of some petty detail. There are usually more gun-divisions than there are deck-divisions; there are ships in which the gun-divisions and the deck-divisions are identical, but such cases are generally the happy result of coincidence and sometimes the result of decision so arbitrary as to excite marvel. There is constantly to be found, in all sizes and classes of ships, the strenuous insistence on having exactly *four* deck-divisions—what is the magic of the number *four* in this connection? It is convenient and perhaps necessary to have four parts to a division, but why must there be four divisions? Why not have two or three or five or eight or whatever number the characteristics of the ship call for? Is it because the sailing-ship of three masts divided naturally into four parts?

The attempt to have four deck-divisions and to have them coincide with the gun-divisions leads to many patent absurdities, in distribution either of personnel or of guns or of both. Cases are known where deck-divisions were made equal in strength, and, as gun-divisions manned varying numbers of even the same caliber of guns, some guns were over-manned, while others were under-manned. In other cases such endeavor has resulted in one officer's being burdened with the care and training of a division which manned eight, ten, and even twelve intermediate guns.

Summary.—Certainly the conditions cited above are evidences of too much centralization and too little division of labor, of the lack of a logical system of organization and administration, and of the absence of uniformity even in what there is.

PART III. THE NAVY AS IT MIGHT BE.

SOME REQUIREMENTS.

The species of organization now used on board ship is the result of the modification of that employed in the days of sailing-ships when, generally speaking, every ship had three masts and three decks. Skeleton forms of watch, quarter and station bills, and of interior arrangements, were provided; all that the executive

officer had to do in order to organize his ship's company was to fill in these forms with names, and the organization was complete. Furthermore, all were similar; when one was learned, all were learned; what was found on one ship was to be encountered on the next in almost identical form. It was, in fact, the day of the *standard ship* and, such as it was, of *standard organization.*

When the modern ship came in, it could not be directly applied; so it was modified and transferred from old to new in modified form; each executive officer, with his captain's approval, modified it to suit his own ideas on his own particular ship; the results to-day are, so far as personnel is concerned, that even sister ships differ markedly in their organization.

It has been said that this method was permitted because nothing else was possible; this is true in that the old organization was not based on any fundamental principles and the continuance of empirical methods was inevitable in modifying the sailing-ship organization; the situation to-day in this regard calls for standardization of organization and administration; it has been suggested in this connection that the skeleton forms be again brought into use.

From the present outlook we are not likely ever again to have a *standard ship* in the sense that the old sailing-ship, with her three masts and three decks, was standard; nor are we even likely ever to have standard ships of certain types or classes; therefore we are not likely to find any forms of skeleton watch, quarter, and station bills of the old type that will serve; certainly it would be extremely difficult to devise any that would meet present conditions. Furthermore, the complications of the control and supervision of personnel on board a modern ship are so great that an organization of the old type must needs be overwhelming in its mass of detail, and hopelessly confusing even to him who has that master-key to its solution, the watch-number.

It would seem that there must be some other way of standardizing the organization on board ship into uniformity; there must be a standard type, or system, of organization that is applicable to all ships; it is believed that such a standard system is possible and that it is of such character as to meet all reasonable requirements. If there can be established such a system, one that is adequate and based on the principles of organization and administration in a reasonable and applicable manner, details may be altered as may from time to time become necessary, without disturbing either the

system or the personnel in any degree. *A system can cope with any "state of transition"* if it be founded on proper and logical principles.

The requirements of such a standard system of organization would seem to be as follows, that:

1. It divides personnel into "groups under leaders."
2. The division into groups is uniform on all ships.
3. It defines individual responsibility and authority.
4. Responsibility and authority are uniform on all ships and throughout the service.
5. It is based on the arrangements necessary in *action* under way.
6. It is, in general, applicable to all ships.
7. It affords certainty of control and ease of administration.
8. It admits of speedy and efficient mobilization of crews and their subsequent "*shaking-down.*"
9. It admits of *transfer by groups* to other ships.
10. It admits of the full employment of the "aids to efficiency."

SOME SUGGESTIONS.

From consideration of the foregoing principles, conditions, and requirements, it would seem that the following suggestions are reasonable and pertinent:

The Executive Officer and the Divisions.—The executive officer should assign, to each division as a whole, specific *division duties* in regard to manning armament, emergency-drills, cleaning ship, care and preservation of ship structure, boats, ship's work, landing force, special details, etc. Each division should also have assigned to it a certain part of the ship, or compartment, as its own particular quarters for messing, berthing, and general living-space.

Officers commanding divisions should have direct charge of the records, rating, drill, exercise, instruction, and clothing of the men of their respective divisions, and of their assignment to stations and details as regards guns, ammunition supply, emergency stations, watches, ship's duty, boats, special details, etc. They should be held responsible for the entire performance of all duties that can be assigned to divisions as group-units and, to as great a degree as is consistent and reasonable, for the entire performance of the individual men of their respective divisions. They should be allowed the proper authority in regard to the personnel

of their divisions and should be permitted as much latitude in arranging and handling their divisions as may be possible while retaining a certain degree of uniformity as to methods. Given the requisite authority, they must needs have its inseparable counterpart, responsibility, and be held to a strict accountability for the good order and efficiency of their respective divisions; if the division, or any part of it, fail to properly perform its allotted division duty or to be ready to do what is expected of it, the officer commanding the division is responsible and must take the consequences.

Were the above conditions to obtain, there would be brought into operation the two fundamental principles of "division of labor." The executive officer would be freed from a mass of work not properly belonging to his office as aid of the commanding officer of the ship; he would be able to exercise a broader scope in the execution of the functions of his office and to give a greater attention to the general administration of the ship, her needs, and her efficient condition for any and all duties that she may be called on to perform; he would be able to do this while in no way relinquishing those proper functions of inspection and supervision which are his as the representative of the captain. The officers commanding divisions would be called upon to exercise those functions properly belonging to officers of the grade of "base-group leader" and would receive that valuable training in the exercise of authority, ability, and judgment which is so patently an essential part of their careers and their education for the higher commands.

Petty Officers vs. Rated Men.—It is believed that the best interests of discipline and efficiency require careful consideration of the question of "petty officers." There are two illogical and irregular conditions now obtaining in this regard: (1) It has become the practice to allow the title and standing of petty officers to a large number of men on board ship whose duties and training are not in the way of command; the presence of so many pseudo-petty officers has operated to nullify the importance, the authority, and the employment of the *actual* petty officers; (2) conditions in the service have operated to nullify the employment of the actual petty officers, though in late years this condition of affairs has improved by reason of the great increase of enlisted personnel and the relatively small increase of officers, but it is by no means yet the general practice to require of the actual petty

officers the performance of their proper functions as "leaders of subgroups in base-groups."

It is suggested that the title and the standing of "petty officer" be withdrawn from all pseudo- petty officers and that they be called "rated men"; it is further suggested that the eagle be removed from their rating-badges, their classifications being retained as at present, which will serve not only to distinguish their abilities but to afford a basis of control among themselves. These pseudo- petty officers are to be found entirely in the "artificer" and "special" branches of the enlisted force.

Division-Duty vs. Watch-Duty.—Within reasonable limits, the division-duty of officers commanding divisions should take precedence over watch-duty; they should be considered "division and watch officers" rather than "watch and division officers," in port at least.

Changes of Personnel.—It is believed that by limiting the commission of a ship to *two* years, it would be more nearly possible to arrange that her personnel should remain unbroken by change; during the two-year commission no officer or man should be detached except for the weightiest reasons. If the ship is fit to remain in active service at the end of a two-year commission, all possible changes should be made in her personnel with the idea that her complement may remain unbroken for another two-year period.

Within the ship, officers and men should be shifted only for cause and, in general, only when such change will manifestly produce greater efficiency, not in any one particular, but in the consideration of the ship as a whole.

If "permanence of association" and utilization of the spirit of competition have proved so essential and so productive of efficiency in gunnery, it is reasonable to expect that they will give good results when applied to all the duties on board ship; conditions should be made favorable for "permanence of association," at least, to give its great assistance in attaining efficiency.

Ammunition Supply.—Rapidity and accuracy of *working the guns* has reached the present high degree of excellence largely through the work of officers commanding gun-divisions in training personnel and in reporting and remedying defects in materiel. If the officers commanding gun-divisions be made responsible each for his own ammunition supply and, further, if rapidity of ammunition supply be made an indispensable factor in attaining rapidity

of fire in *all* guns, may it not reasonably be expected that the problems of ammunition supply would come to be solved, as have those of working the guns, to the increase of *battle* efficiency and the attainment of a *true* measure for rapidity of fire? The turret officer has to do this; why not the officer commanding a division of intermediate or secondary battery guns?

It would seem feasible to so alter the requirements of target-practice that the rapidity of fire attained is in all cases based on the true measure, by making facilities of ammunition supply enter into the measurement of rapidity of fire, as it certainly would in action. The pointer of a turret-gun is dependent on the ammunition-crew in attaining his rapidity of fire; why should not all pointers be on the same basis in this respect?

In this connection it may be remarked that it would seem possible to class facilities of ammunition supply, in regard to hits per minute to be attained, in a manner analogous to that already existing in the case of guns and mounts on account of differences in construction and equipment.

Abolition of the Powder-Division.—It is believed that the powder-division, as a division, should be done away with, its personnel and its duties as a division being divided up among the gun-divisions. The assignment of the division duties in this way presents no difficulties of any importance; there should, however, be provision made, in regard to personnel, for those few officers and men whose duties are so general or so special as to preclude the advisability of their belonging to any division; it is proposed to collect all such individuals into what may well be called the "ship's staff," and to so provide for their employment at all times that they always perform duties of a staff or auxiliary character; it is feasible and logical to do this, as will appear when the composition of the "ship's staff" is elaborated. As already remarked, there is nothing in the duties of the present-day powder-division, either in ammunition supply or in emergency stations, that precludes the practicability of dividing up those duties among the gun-divisions; in fact, in view of individual ammunition-hoists and the water-tight subdivision, the duties now assigned to the powder-division can be far better arranged for in control and supervision in this manner than could in any way be possible under present-day methods.

Uniform System of Organization.—With the disappearance of the powder-division and the bringing into prominence of the gun-

divisions, the crew divides itself into logical "groups under leaders"; namely:

I. Gun-divisions.
II. Engineer force.
III. Ship's staff.

The engineer force is already well-defined in its status. The ship's staff will be taken up later. The chief basis of uniformity lies in the consideration of the *gun-divisions.*

In order to make gun-divisions as nearly uniform as possible on all ships, they must be considered as base-groups which each man a certain number of a certain class of guns—heavy, intermediate, secondary—which number should be as nearly as possible the same on all ships. It is to be noted that this is already the general practice in the case of the center-line turret and the pair of broadside 8-inch turrets.

The "Ship and Gun Drills" and the "Gunnery Instructions" divide guns into three classes: heavy (8-inch to 13-inch inclusive), intermediate (4-inch to 7-inch inclusive), and secondary (3-inch and less). There are three recognized classes of turrets: superposed, heavy (10-, 12-, or 13-inch), and light (8-inch). Turret-divisions are well-established in three corresponding classes which may be called, respectively:

Superposed turret-divisions.
Heavy turret-divisions.
Light turret-divisions (pair of 8-inch turrets).

This classification covers all turrets and the divisions that man them; so universal is the practice in regard thereto that these classes may be considered *standard.*

Consideration of the "requirements" given as essential to a uniform system of organization shows that turret-divisions fulfil the requirements to a marked degree. It would seem that if the other gun-divisions on board ship can be similarly standardized, the desired system of organization is at hand. It is believed that this can be done by the standardization of the numbers of intermediate and secondary guns to be manned by gun-divisions of those classes and the inclusion of the personnel of the ammunition supply in their personnel.

Examination of ships as to (1) number of intermediate and secondary guns carried and (2) facilities of supervision and control in the grouping of guns of those classes, indicates that the

standard numbers of intermediate and secondary guns to be manned by gun-divisions of those classes are *four* and *six* respectively, as multiples of those numbers, the grouping of guns, and the facilities of supervision and control most nearly agree. The suggestion is made that *four* and *six* be considered the *standard* numbers of guns to be assigned to *intermediate* and *secondary* gun-divisions respectively; it is not intended that these classes of gun-divisions are to be limited to manning exactly those numbers of guns, but it is intended that endeavor should be made to adhere as closely to those numbers as the circumstances permit.

Turret-divisions already include their ammunition-crews; as organized at present they are composed wholly of men of the seaman branch. The dividing-up of the personnel and duties of the powder-division renders it advisable and logical to so distribute the ship's complement (except, of course, engineer force and ship's staff) that each gun-division has its quota of the several ratings. That this is necessary will be seen by referring to the "requirements" essential to uniform organization. The *gun-division*, constituted as outlined, may best be defined as follows:

With a suitable ship's staff and engineer force, the gun-division should be so composed, as to numbers and ratings of its personnel, as to suffice to fully man a ship which carried only the exact number of guns considered standard for that class of gun-division.

The question now arises as to the number of men necessary to man the standard divisions of the several classes. Examination of the "Ship and Gun Drills" shows that standard numbers of personnel may be assumed by taking the averages of the numbers therein set down for gun-crews and ammunition-crews. By so doing, turret-divisions are readily disposed of, but in regard to intermediate and secondary gun-divisions only the numbers for gun-crews are available. Judging from what information is obtainable, from the powder-divisions of certain ships, and the requirements of the case, it seems that for *intermediate* gun-divisions the quota for ammunition-crews should be equal to *half* the strength of the gun-crews; for *secondary* gun-divisions a quota equal to *two-thirds* the strength of the gun-crews would seem to be necessary.

Since 4-inch guns are the largest caliber now made in "rapid-fire" guns, it may be well to class them as secondary guns. The number of men in an *intermediate* gun-crew has been taken as *ten*, and in a *secondary* gun-crew as *six*.

From the foregoing data and assumptions the following table has been made up to show the number of officers and the average number of men necessary to man the *standard armament* of the five classes of gun-divisions:

Class of Division.	Number and caliber of guns manned.	Gun-crews.		Amm.-crews.		Totals.	
		Off'rs.	Men.	Off'rs.	Men.	Off'rs.	Men.
Superposed turret	2—12- or 13-inch, and 2—8-inch.	1 | 2 1 |	22 | 34 14 |	1 | 2 1 |	30 | 50 20 |	4	84
Heavy turret	2—10-, 12-, or 13-inch.	1	22	1	30	2	52
Light turret	4—8-inch in 2 turrets.	2	32	1	40	3	72
Intermediate gun	4—7-, 6-, 5-, (4)-inch.	1	40	1	20	2	60
Secondary gun	6—(4)-, 3-inch or less.	1	36	1	24	2	60

It is to be expressly understood that the above totals are for gun- and ammunition-crews only and do not include "*battle-details*," which are:

(a) Fire-control party.
(b) Repair party.
(c) Ship-control party .
(d) Hospital corps.
(e) Electricians.

The employment of the repair party, electricians, and hospital corps is obvious. The fire-control party includes all personnel for range-finding, spotting, range-keeping, and battle-order transmission. Ship-control party includes quartermasters, signal-men, speed-control men, messengers, etc. Each of these parties is under the direct control of an officer of the ship's staff, and the leading men of each party are of the ship's staff; the remainder of the personnel of the ship's staff goes chiefly to complete the fire-control, repair and ship-control parties. The other members of the "battle-details" are obviously men of the proper ratings and of suitable abilities detailed thereto from the gun-divisions.

If it be desirable for unity of control of gun-fire, for efficiency of fire-control, or for uniformity in methods of training gun-crews, the senior gun-division commander may be made, in these connections, battery-commander, battery being taken to mean all guns of the same caliber.

An essential group of the battle-complement has not yet been dealt with—the torpedo-personnel. The suggestion is made that torpedo-crews be made a part of the secondary, or torpedo-defense,

divisions, as torpedoes are not used in torpedo-defense and secondary guns are not employed in ship actions. It would seem that this disposition of torpedo-crews may well be made until one of three things happens: (1) the torpedo is used in torpedo-defense; (2) the secondary battery guns are so protected and so increased in size as to make their crews reasonably safe and their fire of some efficacy in action; or (3) the torpedo-installation be developed to such a degree as to call for a separate class of division, in which case mining operations should be included in the duties required. It is believed, however, that the best all-around solution is to include torpedo-personnel in torpedo-defense divisions; this situation is what obtains on board torpedo-craft.

It would seem to be advisable to class torpedo-defense as an emergency-drill and to provide for it as such. Repelling torpedo-attack is as fully an emergency as fire or collision, if not more so; it has some features in common with other emergency-drills, and it has some features peculiarly its own.

The Ship's Staff.—As already stated, the ship's staff is composed of those officers and men on board ship whose duties are so general or so special as to preclude the advisability of their belonging to any division, and of those men whose duties are such that even the largest ships carry but one or two of the rating. Their duties are to be so arranged that they are always employed in duties of a staff, or auxiliary, character. Perhaps the clearest way to emphasize the ship's-staff idea is to give the composition of its personnel, both officers and men:

Officers.—Executive officer, navigator, ordnance officer, surgeon, paymaster, officers on special duty.

Warrant Officers.—Boatswain, gunners, carpenter, pay-clerk.

Chief Petty Officers.—*All* chief petty officers except chief turret-captains and those of engineer force.

Others.—Yeomen, printer, sailmaker's mate, officers' stewards, officers' cooks, blacksmith, plumber and fitter, band, etc. It will be noted that all of the above personnel belong to the "ship's staff" by reason of their employment.

Examination of the established complements of ships will show that the number of the personnel of a "ship's staff" is very nearly according to whether the ship is (1) battleship or armored cruiser, or (2) a smaller ship; hence it would seem proper and logical to consider that ships' staffs are of two classes, according

to size of ship. Employment of the ship's staff in action has already been outlined in connection with the "battle-details"; its further workings will be taken up under "Administration."

ADMINISTRATION.

Administration of a ship's company organized, as outlined, in accordance with the principles of organization and the other requirements of uniformity and efficiency, resolves itself principally into dealing with (1) gun-divisions, (2) engineer force, and (3) ship's staff.

The executive officer has general charge, under the captain, of the assignment of division duties and of staff duties and has supervision and control over the performance of all duties on board ship; he is, in a sense, the chief of staff.

The officers commanding the gun-divisions and the engineer force are responsible for the proper performance of duty and the efficient condition of their respective commands; the method of dealing with them is obvious.

The officers of the ship's staff have, to assist them in their special duties, warrant officers and chief petty officers. These special duties of the ship's staff call for the employment of certain groups of men, none of which is of such character as to require the existence of a separate division; such groups may be called the *"permanent"* and *"semi-permanent" details.* These groups are made up of men specially qualified or selected for their respective duties as indicated by their ratings; these ratings may be permanent or semi-permanent in character, hence the two classes.

The "permanent" details are: Quartermasters, ship's cooks, artificers, hospital corps, electricians; the "semi-permanent" details are: Signalmen, mess-cooks, captain of hold, lamp-lighter, etc. There is but one general rule necessary to indicate the relative status of the ship's staff and the "permanent" and "semi-permanent" details: *"When performing the work for which they are specially rated, they are under the direct control of the proper members of the ship's staff; in all other connections they are under control of the officers commanding their respective divisions."*

The *"battle-details,"* as has already been stated, are each under the control of the proper member of the ship's staff and the leading men therein are of the ship's staff; they are completed by the

other members of the ship's staff and by men, suitable as to ratings or abilities, detailed from the divisions.

In regard to *temporary details* of any kind it is only necessary to note that they may be under the control of (1) a member of the ship's staff, or (2) the senior officer or petty officer of the detail, and that the latter case covers men on watch or on guard.

Special details other than those already commented on are provided for by assigning to each division its proportionate quota of such details, which are to be filled by the assignment of suitable men by the officers commanding the respective divisions.

INTERNAL ORGANIZATION OF DIVISIONS.

Gun-Divisions.—Following the principles of organization and basing it on the requirements of action, the internal arrangement of a gun-division at once resolves itself into:

Gun-section—composed of the gun-crews.
Ammunition-section—composed of ammunition-crews.
Detail-section—composed of men for the "battle-details."

In general, in action, the *gun-section* is under the immediate command of the officer commanding the division; the *ammunition-section* is under the command of a junior division officer; the composition of these sections is obvious. The *detail-section* is composed of men who are assigned to the "battle-details" and should be made up, as far as possible, from those men of the division who belong to the "permanent" and "semi-permanent" details.

The subdivision carried further is based on the assignment of *squads* (i. e., groups of men) to groups of duties or stations, so that in emergency-drills, for instance, a certain group of duties will be performed whether or not the entire squad is present—to assign individual duties is to leave something of importance undone at just the time it is needed. This method is, of course, but the logical continuation of the principles of organization in that each squad would have its leader, responsible for his squad. In this connection it is to be noted that the integrity of the gun-section, ammunition-section, gun-crews and ammunition-crews may be preserved and their group-arrangement made use of; the battle-organization shows its adaptability to other conditions, for here are ready-made squads; gun-crews are squads in themselves and even turret ammunition-crews divide readily and naturally into

shell-squad and powder-squad. For instance, a heavy turret-division would have a minimum of six squads available—two gun-crews, two shell-squads, and two powder-squads—with one additional squad in the detail-section to be regularly stationed, or held in reserve, according to requirements; if circumstances call for it, each squad may be divided into two parts, each under a leading man.

Engineer Force.—The engineer force has the following obvious division into groups, as to ratings and employments:

Engine-room section.

Fire-room section.

Watch-sections are made up of equal proportions of engine-room and fire-room sections and may be either three or four in number. It would seem desirable to "squad" the men and their duties as much as practicable. The engineer force follows the same general lines as to division requirements as do the gun-divisions; in fact, the only changes necessary to the well-established status of the engineer force are, to extend the authority of the senior engineer officer to the quarters of the engineer personnel and the control of their records and ratings.

It may be remarked in regard to gun-divisions and engineer force that there is a certain similarity of functions between gun-sections and engine-room sections, and between ammunition-sections and fire-room sections.

SUMMARY.

The desirability—not to say necessity—of having a standard system of organization must be admitted by every one who has given due consideration to the subject of organization on board ship. The large numbers of men on board our ships and the size and characteristics of the ships themselves preclude the advisability of continuing the methods at present in use. Endeavor has been made in the foregoing "suggestions" to bring forth a system of organization that disturbs established conditions as little as possible in attaining the desired and requisite results as to *uniformity, system,* and the embodiment of the *principles* of organization and administration. It is believed that consideration of the "requirements" set down as proper and necessary to a *standard* system of organization will show that each and every one of them is necessary and reasonable. It is further believed that due con-

sideration of the "suggestions" will show that they meet the "requirements" in a logical and practical manner.

The following principal changes are involved:

1. The freeing of the executive officer from an unwieldy mass of detail, while in no way detracting from his proper supervision and control.

2. The increase of the responsibility and authority of the officers commanding divisions.

3. The abolition of the powder-division and the establishment of a ship's staff.

4. Definition of the authority and responsibility of officers commanding divisions and of the ship's staff.

5. Standardization of gun-divisions into five classes so that, as nearly as possible, a given class of gun-division will man the same number of guns on any and all ships.

6. The inclusion of the personnel of the ammunition supply in the personnel of all *gun*-divisions.

The whole gist of the changes will be seen to center in (1) the standardization of gun-divisions as to personnel and manning armament, and (2) the bringing into prominence of the *division* as the *base-group* to be dealt with on board ship.

As the changes chiefly concern the gun-divisions and the officers commanding them, there will be set down here a summary of the status of the gun-divisions as intended; they are to:

(a) Be composed of men of all ratings (except engineer force and ship's staff) in quotas proportionate to the class of the division.

(b) Man and maintain certain assigned guns and the accompanying means of ammunition supply, according to class of division as to numbers and caliber of guns.

(c) Man and maintain certain assigned portions of the gear used in emergency-drills and exercises.

(d) Man and maintain certain assigned boats.

(e) Maintain certain assigned portions of the ship structure and its equipment.

(f) Furnish a proportionate quota of petty officers and men for the permanent, semi-permanent, special, battle, and temporary details.

(g) Be stationed, drilled, instructed, and trained by their own officers in all that relates to their duties as divisions.

(h) Be supervised, directed, and controlled by their own officers and petty officers in all division administration and employment.

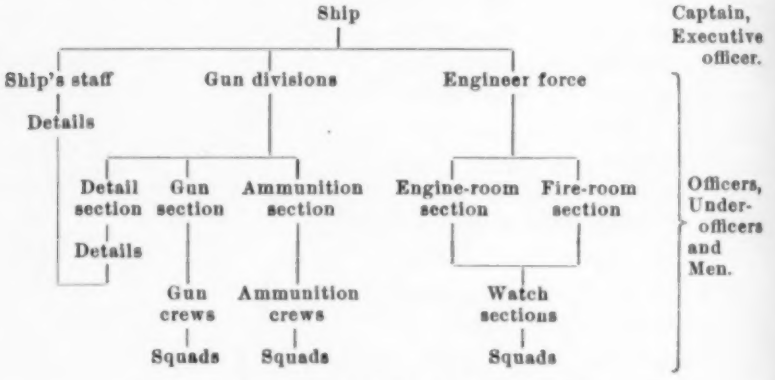
(i) Have each its own particular quarters for berthing, messing, and general living-space.

(j) Be organized internally on the basis of the arrangements necessary in action.

In regard to the engineer force it need only be said that the above status is to obtain in regard to the engineer personnel and their duties in the operation and maintenance of the propelling machinery, and in other matters, as nearly as possible. It is to be remarked that the engineer force is established very nearly in this status at present.

In the consideration of the system suggested there may be called to mind the fact that, as in the case of practically all changes that are adopted, it would have been practicable and efficient at any time in the past.

It would seem that, under the system proposed, the organization on board ship may be diagramed as follows:



PART IV. PERMANENT ORGANIZATION.

The desirability of permanence in the enlisted personnel of the navy is obvious, and much has been written about ways to keep men in the service; many ideas for the attainment of this desirable state of personnel have been brought forward—aids to contentment, more pay, more liberty, better food, etc. So far as is known there has never been advanced in this connection a principal aid to efficiency—permanence of association—and its usual consequent—esprit de corps; it is, however, commonly known that many men re-enlist to be with comrades in the service, or to remain on a ship where the associations are pleasing or the achievements of the ship a source of pride.

A principal advantage of permanent organization is in connection with recruiting. There are two general methods of keeping up personnel: (1) by replacing losses in already organized groups by recruits, (2) by allowing organized groups to pass away and replacing them by groups newly formed. All experience goes to show that the first method is in all respects the better; it is the one in almost universal use. Permanence of association and esprit de corpt can exert their full influence only in permanent organizations. Recruits joining an old organization speedily learn their duties and take the tone of the experienced men, from whom they acquire, almost unconsciously, a great deal of practical information that is neither taught at drill, learned from books, nor imparted by instruction. They come at once under the command of experienced leaders and can be rounded into shape in the least possible time. They are inspired, too, by the esprit de corps of an organization that has made a name for itself or has gained confidence and ability from experience and long association.

It cannot be gainsaid that permanent organization would promote efficiency in the navy; the only question about it is as to what "groups" to make permanent in their organization. The crew of a ship can never be more than "semi-permanent" in character, as ships cannot remain indefinitely in commission and they vary in size and characteristics. The ship's company is composed of "base-groups" as follows:

I. Gun-divisions.
II. Ship's staff.
III. Engineer-division.

It is patent that unless permanent organization can be applied to the above component parts of a ship's complement, it cannot be applied at all, as it is impracticable to deal with groups containing fewer numbers. The suggestions of this paper as to permanent organization are applied to the consideration of the above-named component groups of a ship's company. It is not claimed that every possible type and size of craft can be provided with personnel made up of permanently organized component parts, but it is claimed that the majority of ships can be so provided. Consideration of what has been said as to principles, requirements, and suggestions will show that there presents itself a logical further step in organization on board ship, and consideration of the requirements in particular will show the advisability of such a step.

GUN-DIVISIONS.

The practicability of standardizing gun-divisions into five classes affords an available and logical basis for permanent organization of the personnel composing them. There are five classes of gun-divisions, each manning certain numbers of certain classes of guns, and the definition of a gun-division has already been given as:

> With a suitable ship's staff and engineer force, the gun-division should be so composed, as to numbers and ratings of its personnel, as to suffice to fully man a ship which carried only the exact number of guns considered standard for that class of gun-division.

The above definition shows that each gun-division is intended to contain its proportionate quota of the ratings not included in the engineer force and the ship's staff. The five classes of gun-divisions and their corresponding average numbers of enlisted personnel for gun- and ammunition-crews are:

Superposed turret-division (S. T. D.)	86 men.
Heavy turret-division (H. T. D.)	52 "
Light turret-division (L. T. D.)	72 "
Intermediate gun-division (I. G. D.)	60 "
Secondary gun-division (S. G. D.)	60 "

Each gun-division should include in its personnel, *additional* to the numbers given above, those men whose ratings obviously call for their assignment to the " battle-details "—quartermasters, hospital corps, electricians, signalmen, bugler, etc.—such men compose the " detail section " of a gun-division.

Careful examination of the established complements of ships and their comparison with the definition of a gun-division lead to the following tentative conclusions as to numbers and ratings:

(a) That the five classes of gun-divisions shall be identical in numbers and ratings to the limit of the number composing a " heavy turret-division," which is the smallest and also the most fundamental.

(b) That the other classes of gun-divisions shall be increased from the basis of the " heavy turret-division " chiefly by additional ratings of the seaman branch and of electricians in proportionate quotas.

(c) That there shall be allowed to each intermediate and secondary gun-division a leading petty officer called " leading gun-captain," whose duties shall be similar to those of a " turret-captain," and that the latter shall be considered the " first petty officer " of the division.

(d) That the tentative allowances in numbers and ratings for the five classes of gun-divisions shall be that set down in the following table, in which is also given a column showing the probable employment of the several ratings in the battle-division duties and "battle-details"; in this table only the names of the several ratings have been given, it being assumed that the men will be of the classes in the ratings to which their abilities and experience entitle them:

Rate.	S. T. D.	H. T. D.	L. T. D.	I. G. D.	S. G. D.	Battle Station.
Turret Captain or Leading Gun Captain.	2	1	2	1	1	Division.
Master-at-Arms	1	1	1	1	1	"
Boatswain's Mate	3	2	3	2	2	"
Coxswain	6	4	5	4	4	"
Gunner's Mate	4	3	4	3	6 (4 torp.)	"
Quartermaster	1*	1*	1*	1*	1*	Ship Control.
Signalmen	2*	2*	2*	2*	2*	" "
Seamen	60	32	46	40	37	Division.
Ship's Fitter	1	1	1	1	1	"
Carpenter's Mate	1*	1*	1*	1*	1*	Repair.
Painter	1	1	1	1	1	Division.
Electrician (Div.)	1	1	2	1	1	"
Shipwright	1	1	1	1	1	"
Electrician (Ship)	2*	2*	2*	2*	2*	Electricians.
Ship's Cook	2	1	2	1	1	Division.
Baker	1	1	1	1	1	"
Hospital Apprentice	1*	1*	1*	1*	1*	Hosp. Corps.
Bugler	1*	1*	1*	1*	1*	Ship Control.
Division Yeoman	1	1	1	1	1	Division.
Mess Attendant	2	2	2	2	2	"
Battle-details (*)	8*	8*	8*	8*	8*	
Gun and Amm. Crews	86	52	72	60	60	
Total enlisted	94	60	80	68	68	
Officers	4	2	3	2	2	
Totals	98	62	83	70	70	

One thing to be noted is that the allowances given above as standard would probably increase the total number of artificers carried on any one ship, but this is rather an advantage than otherwise. It is to be remembered that the above allowances are *tentative* and are intended to be considered *standard*, but any given division may have its personnel increased or decreased to meet particular conditions by simply changing the number of *seamen* allowed, during the particular time of service under consideration and according to the conditions thereof, the remainder of the division complement remaining as specified.

SHIPS' STAFFS.

It was remarked when treating of the composition and functions of a ship's staff that examination of the established complements of ships will show that the number of the personnel is very nearly

according to whether the ship is (1) battleship or armored cruiser, or (2) a smaller ship, and that hence it would seem feasible to consider that ships' staff are of two *standard* classes; the following table of allowances of personnel is made up on this basis:

SHIPS' STAFFS.

ENLISTED.				OFFICERS.			
Rate.	1st Class.	2d Class.	Battle Station.		1st Class.	2d Class.	Battle Station.
Chief M.-at-A..	2	1	General.	Exec	1	1	General.*
Chief B. M.....	1	1	Repair.	Nav.....	1	1	Ship Control.
Chief G. M.....	2	1	General.	Ord.....	1		Fire Control.
Chief Q. M.....	2	1	Ship Control.	Surg.....	2	1	Hosp. Corps.
Chief Elec.....	2	2	Elec. Power.	Paym....	1	1	Fire Control.
Chief Carp. M..	1	1	Repair.	Bos'n....	1	1	Repair.
Blacksmith.....	1	1	"	Gunner.	2†	1	General.
Plumb. & Fitt'r.	2	1	"	Carp.	1	1	
Sailmaker's M..	1	1	"	Pay Clk.	1	1	
Printer.....	1	..	Fire Control.	Totals..	11	8	
Chief Yeoman..	5	3	Fire Control and Ship Control.				
Yeoman	6	4					
Hosp. Steward..	1	1	Hosp. Corps.				
Comm. Steward	1	1	General.				
S. Cook, 1st cl...	1	1	"				
Cab. Steward...	1	1	Hosp. Corps.				
W. R. Steward..	1	1					
J. O. Steward...	1	..					
W. O. Steward..	1	1					
Cab. Cook.....	1	1					
W. R. Cook....	1	1					
J. O. Cook.....	1	..					
W. O. Cook.....	1	1					
Mess Attend't..	4	4					
Band.....	16	..					
Totals.....	57	30					

* Repair.
† 1 Electrician.

It is intended that the above allowances be considered *standard;* they will be found to agree very closely with established complements in all respects.

ENGINEER FORCE.

The engineer force is the most difficult to dispose of in a satisfactory manner as to permanent organization. Examination of established complements affords the only means of comparison, and some of these are confusing because of evident inconsistencies. Examination leads at once, however, to the conclusion that the engineer force must be considered as composed of two separate parts: *engine-room* section and *fire-room* sections.

Engine-Room Section.—The most that can be said about engine-room sections is that they occur in three classes, numbering in personnel approximately 24, 36, 48. There seems to be no comprehensive rule for their occurrence in these classes except that the first class (24) is found in small cruisers and in scouts; the second class (36) is by far the most common and is found chiefly in battleships; the third class (48, twice the strength of the first class in all ratings) is found in recent armored cruisers and in battleships now building. Perhaps a clearer idea of these three classes of engine-room sections will be gained by giving names of ships, one name covering all of a type and class; i. e., sister ships.

1st Class (24).	2d Class (36).	3d Class (48).
2 Albanys. 2 Cincinnatis. 6 Chattanoogas. 3 Birminghams.	3 Alabamas. 6 Connecticuts. 3 Indianas. 5 Georgias. 3 Maines. 2 Kentuckys. 2 Idahos. 2 Michigans. 3 Charlestons.	4 Delawares. 4 Montanas. 6 Californias.
13 ships.	29 ships.	14 ships.
	Total of 56 ships.	

From the above table it will be seen that 56 ships have been considered. There follows a table, showing the allowances for the three classes of engine-room sections in ratings; each of them carries the additional ratings of coppersmith, blacksmith, and boilermaker, as the occurence of these ratings is similar to that of the engine-room ratings.

ENGINE-ROOM SECTIONS.

Rate.	1st Class.		2d Class.		3d Class.	
	No.	No. in Watch.	No.	No. in Watch.	No.	No. in Watch.
Chief Machinist's Mates	4	2	6	3	8	2
Machinist's Mates, 1st class	4		6		8	2
Machinist's Mates, 2d class	6	4	9	6	12	3
Oilers	10		15		20	5
Blacksmiths	24	6	36	9	48	12
Coppersmiths	1		1		2	
Boilermakers	1		2		2	
	1		1		2	
Totals	27		40		54	
Warrant Machinists		2		2		2

It will be noted that the first- and third-class sections are respectively one-third less and one-third greater in all ratings than the second-class section, and that the third-class section is twice the strength of the first in all ratings.

Fire-Room Sections.—Examination of the designed horse-power, boilers, and of the fire-room complements of ships affords the following data on which to base permanent organization of fire-room sections:

(a) That B. and W., Thornycroft, and cylindrical single-ended boilers occur in multiples of *four* and Niclausse boilers in multiples of *eight,* and that groups of *four* and *eight* boilers respectively approximate 5600 designed H. P. average.

(b) That the ratio $\frac{\text{fire-room personnel}}{\text{designed H. P.}}$ has an average value of $\frac{1}{90}$ and varies little from the average.

From the above facts it would seem that a *standard* fire-room section may be laid down consisting of $\frac{5600}{90}=62$ men, manning a group of *4* B. and W., Thornycroft, or cylindrical single-ended boilers, or a group of *8* Niclausse boilers. To find the number of fire-room sections for a given ship, divide the total number of boilers by *4* or *8* (according to type of boiler, as given above); the quotient is the number of fire-room sections necessary; it will be found that this method will give satisfactory results.

The composition of a *standard* fire-room section is as follows:

FIRE-ROOM SECTION.

Rate.	No.	No. in Watch.
Chief Water Tenders...	2	..
Water Tenders.....	4	1
Firemen, 1st class.....	12	3
Firemen, 2d class.....	12	3
Coal Passers.....	32	8
Totals.....	62	15
Warrant Machinist.....	1	

TORPEDO-CRAFT.

All that can be said about these craft is that the average complements appear to be: for a destroyer, 70; for a torpedo-boat, 30; for a submarine, 10. It is suggested that crews for torpedo-craft may be standardized, in view of the above facts.

APPLICATION OF STANDARD GROUPS.

The best way of testing the foregoing plan of standardized and permanently organized groups is to apply the methods in actual cases. This will be done by giving six examples—three battleships, one armored cruiser, one small cruiser, and one scout: Michigan, Idaho, Georgia; Montana; Albany; Birmingham.

	Michigan.	Idaho.	Georgia.	Montana.	Albany.	Birmingham.
	Characteristics.					
Battery	8 12-in. 22 3-in. 2 tubes.	4 12-in. 8 8-in. 8 7-in. 12 3-in. 2 tubes.	(4 12-in. (4 8-in. 4 8-in. 12 6-in. 12 3-in. 4 tubes.	4 10-in. 16 6-in. 22 3-in. 4 tubes.	10 5-in. 10 6-pdr.	2 5-in. 6 3-in. 2 tubes.
Boilers	12 B. & W.	8 B. & W.	24 Nicl'se.	16 B. & W.	4 Cyl.	12 Fore R.
	Proposed Assignment of Complement by Groups.					
Ship's Staff.	1st Class.	1st Class.	1st Class.	1st Class.	2d Class.	2d Class.
Gun Divisions	4 H. T. D. 4 S. G. D.	2 H. T. D. 2 L. T. D. 2 I. G. D. 2 S. G. D.	2 S. T. D. 1 L. T. D. 2 I. G. D. 2 S. G. D.	2 H. T. D. 3 I. G. D. 3 S. G. D.	2 I. G. D. 1 S. G. D.	2 S. G. D.
Engineer Force	E.R.S. 2 cl. 3 F.R.S.	E.R.S. 2 cl. 2 F.R.S.	E.R.S. 2 cl. 3 F.R.S.	E.R.S. 3 cl. 4 F.R.S.	E.R.S. 1 cl. 1 F.R.S.	E.R.S. 1 cl. 2 F.R.S.

Comparison of Proposed with Actual Assignment.

	Pro.	Act.	Pro.	Act.	Pro.	Act.	Pro.	Act.	Pro.	Act.	Pro.	Act.
Ship's Staff	57	57	57	55	57	57	57	55	30	30	30	30
Gun Divisions	512	535	552	452	540	479	528	529	204	205	136	172
Engineer Force	226	226	164	167	226	240	302	290	89	92	151	138
Totals	815	818	773	674	823	776	887	874	323	327	317	340

It will be noted that marked discrepancies occur only in the cases of the gun-division personnel of the Idaho and the Georgia; comparison of their batteries and gun-complements with those of other ships would seem to indicate that these two ships are either over-gunned or under-manned by the actual complement. It may be stated that the above examples were chosen at random to represent markedly different types and classes of ships; attention is invited to the coincidence of complements in all respects save the two already commented on.

SOME OTHER ADVANTAGES.

It will be noted that with personnel organized in the manner described, mobilization becomes an affair of comparative ease and certainty, either in peace or war. A ship which is to go into commission has ordered to her, from the home-port barracks or from a ship going into reserve or out of commission, her ship's staff, gun-divisions, engine-room section and fire-room sections; each group is assigned to certain duties and stations as a group; each group-commander proceeds to get his command settled down and in efficient working order; the captain and the executive officer, direct, supervise, and inspect. How long would it take to get the ship fit to go into service under such conditions?

Naval Reserves.—The adoption of such a plan of permanent organization not only would lead to increased efficiency in the service itself, but would simplify the organization of naval reserves, their training, and their employment when needed. Preferably, naval reserves would be organized only as intermediate and secondary gun-divisions and as engine-room and fire-room sections; as intermediate and secondary gun-divisions because they can be furnished the guns of those classes wherewith to make themselves proficient; as engine-room and fire-room sections because there are a large number of men in civil life available for their composition. Organized along these lines, naval reserves could be definitely counted on for employment by the Navy Department; their instruction and training could be carried on along well-defined lines, making them efficient and available for service to an extent obtainable in no other way. The naval reserve organizations could then be readily utilized to fill up the complements of ships in reserve, newly completed, or newly purchased; probably it would not be advisable to wholly man a ship with naval reserves, but they could readily be placed on a ship in company with a nucleus composed of groups of the regular service. It is suggested that whenever a ship is placed in reserve or out of commission the most efficient naval reserve divisions in the vicinity be assigned to her and that the officers and men of the divisions so assigned be given every opportunity to become familiar with the ship; these divisions should be attached to the ship until she goes into full commission.

Ships in Reserve.—Ships could readily be placed in reserve by leaving on board a nucleus crew composed of the ship's staff and

the desired number of gun-divisions—preferably one of each class on board—and the desired engineer force. The complement should be at once completed by the assignment of the necessary number of naval reserve organizations. At the times for the naval reserves to have their training afloat, the ships in reserve could be put into full commission by completing their complements as described and then employed in such way as the Navy Department may desire, the mobilization being in all respects similar to that which would obtain in the regular service.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

HONORABLE MENTION.

THE REORGANIZATION OF THE NAVAL ESTABLISHMENT.

By PAY INSPECTOR J. A. MUDD, U. S. Navy.

Motto: Truth is indestructible.

I.

Apologies are poor things; but the writer feels constrained to begin this paper with a line of explanation. The aim in what follows is the placing of the industrial and commercial forces of the naval establishment in their proper place in any reorganization that may be undertaken; not in any relative place as to the strictly military forces, but in *their place,* and in doing this to save the whole of the naval establishment from going backwards. The writer wishes to prove that the place of these industrial and commercial forces can never be one of direct subordination to any force except that of the civilian Secretary of the Navy, in any organization that will survive the criticism of the patriotic economist. He is writing against a possible false start. In making his argument, it is necessary to go into somewhat intimate discussion of subjects upon which, otherwise, he would not express an opinion. There is such confusion and interference between the two classes of forces, the strictly military and the industrial and commercial, that in a paper like this, the elements of both must be examined. One from the industrial and commercial world of the establishment cannot treat the elements of the force of which he is not a part as inviolate from his weighings, measurings and placings, and do justice to his subject. After all, if he understands the elements entering into both forces, there seems no impropriety in discussing them. The most important part of the reorganization

question, under present conditions, is the quality of the start; and the realization of that is the reason for this paper. *The industrial and commercial part of the naval establishment is the auxiliary of nothing; it is a main part.* The writer starts with this declaration, and affirms that a beginning ignoring this as a cardinal principle will be a false start.

II.

The present agitation over the reorganization of the Navy Department emphasizes the iconoclastic spirit of even civilized man, and the waste of valuable resource that the power of the voice of the mob generally causes. Every important issue involving changes in system, where many human units are affected, must have connected with it a "mob." Sometimes the "mob," by force of numbers, or by its wits-scattering noise, overawes those who comprise the trained body; this makes revolution, which means material destruction and the beginning all over with starting principles. Again, sometimes there is no such dire result, the "mob," after having its day in Clamor's Court, falling in behind its skilled brethren in orderly manner and marching with them toward the betterment of all. A mob always exaggerates. For instance, a district messenger boy, walking backwards with an urgent letter, is banged to the sidewalk by his own banana peel. The crowd that rushes up declares he has just fallen out of a twenty-fifth story window.

The navy to-day has its "mob," in the service and out; gentlemen good and true, officers patriotic and enthusiastic, but, nevertheless, "of the mob." It is calling for the reform of the naval establishment, and the newspaper people in it blow the horns and beat the drums so as to get more "mob." Is this "mob" going to cause revolution, or, in the end, will it fall in with those of training, controlled by calmness born of the knowledge of their task?

In this day of mechanical living, the organizing of large establishments down to the point of greatest efficiency, with the least expense, is a science of highest order, to be conquered only by the brains, fitted by nature for such work, of men who have had practical experience in the lines embraced. After an establishment has been so organized, into its daily life may enter those who prove themselves giants of usefulness, where, in the original work of organization, their place would have been with the "mob."

One of the points about many volunteer organizers is instead of

starting with what is wanted, they start with what *they* want. A majority of all organizers shape their course from the resources actually at hand, instead of determining what is wanted and the resources necessary to obtain it, and then fitting these findings to the resources at hand, as near as may be; obtaining additional resources; eliminating useless resources possessed; and, if necessary, curtailing the scheme of organization to meet obstacles to perfection that cannot be overcome.

In much that has been written in regard to naval reorganization, there has been confusion of the terms "administration" and "organization." Perhaps if they would get these words straight, the critics might notice the breaking of dawn. Faulty administration is not of itself a reason for change in organization. No organization can be the success that its parts warrant unless it has administration of similar quality. There have been faulty administration and lack of administration in the Navy Department organization in many places at many times. What the navy should have constantly is intellectual administration, ever working, ever studying, ever mending; an administration whose whole thought, only aim is for the navy. A good deal of growling against the present organization has been due to this confusion of the two terms mentioned. Often, were the particular personal element—the administration—removed, by the mind, from the part under criticism, what remained—the organization—would look to the awakened critic like a well-ordered garden as compared with the brambled thicket in view before.

Officers who are to work on the details of a reorganization scheme should be carefully chosen. Rank is a good requisite, but it should not necessarily govern. The men doing the work should have a judicial turn of mind, and be *wise*, if possible to obtain a sufficient number possessing the latter quality, the rarest of good ones.

III.

To improve, or reorganize to a radical extent, one must start at the bottom, as in building operations, the start on the main elements of a structure must be from the ground. In the schemes for the reorganization of the Navy Department that have come to the writer's notice, the start has been made at the top, that being the part in which nearly everyone is interested. This proceeding is vicious, in its probable result to the navy, and the country at large.

If the architects of the present organization made the top, the part exposed to all eyes, so bad (from the view point of critics), is it not likely that they were also faulty in much of the design underneath? Yet some of the men of power in the navy in the last decade have seemed content with starting with a radical change in the top, leaving the underpinnings to be tinkered with afterwards to fit the new top, without a thought of the chance of those props giving way under the new distribution of weight, leaving on the ground, in the end, a crushed organization, smothered by a cracked and senseless top.

Attention to detail is of paramount importance in reorganization work. A few years ago, the writer in preparing a table of the different lines of effort necessary in the great work that finally puts a fleet in commission, drew, for his own entertainment, a chart showing these hundreds of kinds of jobs, with an indication at each of the character of the directive and executive forces required to accomplish it. As under each of these two forces there is a division (though sometimes combined in the same person, office or shop), the supervisory and the active parts of the force, there were indicated on the chart, for each line of work, or "job," four different forces: the supervisory and active parts of the directive force and the same parts of the executive force. The forces were indicated by suitable symbols. This was beginning at the bottom. Similar work ought to be done, by those thoroughly competent, in the early days of planning for reorganization. This may be laughed at by some. Ships are not going to be navigated nor battles fought by means of such charts or with the aid of a card index, but they can be used in the preparation for those efforts. The secretary of the Republican national committee was not far wrong when he tried to start in on the presidential campaign with a card index of colossal proportions.

Remember one thing: the navy is not an army. What might fit the army in the way of reorganization, might no more fit the navy than a pair of boy's pants would fit a mermaid.

The same organization, in main principles, can be made to fit a navy varying in size at different times. That is, a successful organization for a naval establishment maintaining afloat, ready for use, thirty-two battle-ships, would still be all right if ten years from now there were sixty-four ships. Therefore, the technical organizer may safely start with the ultimate end of all endeavor to be

thirty-two first-class battle-ships ready for immediate service; these, and the necessary auxiliaries and the save-all gunboats used in sub-calibre cruising.

IV.

To obtain the proper character and quality of the matériel of this accepted fleet, must be the result of the co-ordinated ideas of those who, having spent their lives in service on battle-ships and other vessels, have risen to the position of directive forces in the fleet personnel and those industrial forces who technically design, build and equip ships, the voice of the fleet force controlling, in all reason; but the voice of those designing, as naval architects, and building to have the same liberty in the forum of the Department as that of the directors of the fleet. The fleet should have the last say in the design and equipment of its units, but the directors from the industrial part of the establishment should be allowed to have their say on any point at any time, without obliged reference beforehand to the directors of the fleet. Is this not sound? The industrial director should not be a direct subordinate of the fleet director, even if at times he is not his peer. At any time the opinion of the industrial people may be more vital to the efficiency of the fleet than that of the sea officers, and in that case there should be the broadest freedom for that opinion to reach the controller of all, the commander-in-chief's executive officer, the Secretary of the Navy.

V.

Besides the character of design and the quality of the inanimate elements making up the fleet units, there are the elements of the personnel, which should be the best. No reorganization will be the success hoped for unless the personnel element is organized down to the fineness of the works of a chronometer; then watched, its error being constantly obtained and corrected, or applied in the problems of the navy's work.

The sea officers of the line should be "best," even at a sacrifice in the rating of the officers on shore, and this best can be had by being true to principle. The sea officer of the line, of the rating "best," cannot be created in time, or found ready on the outside, after the flags of war are hoisted to the trucks; he must be there in the fleet, in necessary numbers, before the quarreling begins. The units of the staff personnel should also be ready before the

bell rings, in order that the fleet may rate "best"; but if the resources are not great enough for this, the disaster therefrom will not be near as far reaching as lack in the other case. The trained medical naval man, of the rating "best," is a fine creation of these modern times of sanitary watchfulness and humane treatment of the suffering, but the battles on the sea could be fought with only the aid of his professional brothers, enlisted at the time the war began, without the main result being affected thereby. Many more salty souls would go down to Davy Jones Locker; but after all, the existence of the unit man in modern sea war is of secondary consideration. And here and there a horse doctor would likely slip in, on account of the confusion and lack of oversight in the first hours of war; and imagine a proud battle-ship closing in on the enemy's line with only a horse doctor on board and nothing but pink-eye medicine in his bag. The so called "pay-officer" of to-day certainly rates up as high as anyone, when classed as a corps. The supplies and accounts corps, handling the stupendous problems of demand and supply of the fleet and the industrial and commercial elements, and the demands for accounting, has been developed to a degree of great efficiency, and in war would be a telling force in maintaining the fleet in readiness. Yet, we might do without these skilled men of experience. But the victory would be a much dearer purchase, in a business sense, than it would have been with a trained corps of officers handling the supply question, the least part of which would not be the provisions lighters. There would often be "empty dinner pails" on board; and when one comes against an aggregation of men with no food in their "pails," war or no war, he is against a problem that allows no time off for recreation or meditation. Nevertheless, so long as Congress paid out the money line, with no thought of bringing things up with a round turn, the supply would be all right for war purposes,—that is, so far as success was concerned. As for accounting; if, as according to a great authority on the subject, war is hell, it could go to the devil, very properly. The naval constructor is also a most valuable asset of the establishment. He is so necessary in the working of the great navy machine that one can hardly imagine how he could be dispensed with in time of war. Yet he could be spared without the main results of the conflict being affected. But never could the fight of the fleet be carried to a successful finish without its ship units being manned by those previously trained in their places on

board, the duration of this training being in proportion to the relative importance of the positions held. So it is the gravest kind of an error to compel or allow these sea officers of the line to perform duty at any time in their career that is not connected directly with the fleet and which does not continue to keep them sized up to "best" in their sea profession.

Now to expose a false premise upon which custom has been established and from which important parts of proposed reorganization have been started. Take the fleet ready for service; there is no one who can tell the sea officers of the line manning the ships what to do in the way of handling them in a naval sense, working the guns, etc., and no other should attempt to interfere in that technical work. But that is absolutely all in the way of immunity of these sea officers of the line from outside interference. Because they have been and must always be the supreme controllers of the great fighting aggregations on the sea, so far as being war machines, it does not follow that they should be supreme controllers of the shore establishment, or even necessarily of war policy and strategy. The people of the country carry on a war, and they are represented in the person of a President, who, as commander-in-chief, has as his executive officers the Secretary of War and the Secretary of the Navy, both civilians. In recent years, on account of the growing importance of the military branches of the government, there have been added, to this controlling force, executive aids to the secretaries, in the person of assistant secretaries, also civilians. Can it be honestly said that this solid, all-controlling civilian top to a highly trained and carefully educated war establishment is a mistake, in a country over one hundred and twenty-five years old, with a record of a number of successful wars of various kinds? The law says:

> There shall be at the seat of the government an executive department to be known as the Department of the Navy, and a Secretary of the Navy, who shall be the head thereof.
>
> The Secretary of the Navy shall execute such orders as he shall receive from the President relative to the procurement of naval stores and materials, and the construction, armament, equipment and *employment* of vessels of war, as well as all other matters connected with the naval establishment.
>
> The business of the Department of the Navy shall be distributed *in such manner as the Secretary of the Navy shall judge to be expedient and proper* among the following bureaus . . . .

The italics are the writer's.

Do not quibble, but continue to look things in the face with an honest connection between conscience and tongue. It seems that the main thing wanted by some of the would-be reorganizers of the naval establishment, particularly those skilled at making roofs, or "tops," while leaving others to finish or change the underpinnings and the foundations, is a body of sea officers of the line legally planted on shore between the civilian "top" and all the rest of the naval establishment. To put such a barrier between the directive forces of the staff corps, in their work connected with the industrial and commercial part of the establishment on shore, and the legal and logical head of the navy, the civilian Secretary, would be as sensible, in this day of hard-headed business, as putting a naval constructor between the captain and the executive officer on board ship. If the officers of the line would realize that one does not have to be a trained sea officer to manage properly the affairs of the great naval establishment, outside the design and technical control of the ships in commission, there would be much plainer sailing toward the goal of perfect economical efficiency. Abraham Lincoln was an excellent general, and there were no stronger men, in a military sense, in the army and navy, during the Civil War period, than the two great secretaries who held sway over the military destinies of the nation.

There have been schemes of reorganization that defined what the Assistant Secretary of the Navy was to do; that is, an intention to have the law state his duties instead of his chief, the Secretary. It would seem that all reorganizers should let the duties of the Assistant Secretary alone. It would not be a surprise to learn that there was a scheme or two in existence that defined the duties of the Secretary.

VI.

The sea officers of the line, as a class, have seemed to labor under the delusion that they "owned," or that it was necessary for them to "own," the whole of the naval establishment. They should "own," bob, hook and sinker, the fleet, ready for business; and he who would decry this statement is poor stuff. But when it comes to the shore part of the naval establishment, there are many acres that they should not own, and villages to which they should have hardly visiting privileges, on account of waste of time.

The power of command is a limited piece of property. Practically, it is confined, in this mechanical world, to the strength necessary to keep the machinery going properly within specified hours. Outside of those limitations, it has no existence in fact; and it is never such a belonging of the unit man as are the color of his hair and the shape of his ears. In the dream world of theory and sentiment, this power is sometimes extended beyond these practical lines, by those who are permitted to exercise it in reality for a brief period; but this magic extension only lasts until it interferes with something doing in the busy world of reality; then it shuts up like a collapsed balloon. In new systems in the highly civilized world, when the weight and value of everything are a matter of record, the privilege of command is given only when it is actually necessary, as oil is to an engine, and the privilege is never continuous. That is, a man may command a thousand workers at 10 a. m., and be but a humble unit at 6 p. m., and he may command on Tuesdays and Fridays and be only himself on Wednesdays. In this new order of things there is no place for him who wants to command solely for love of sway over his fellow mortals. This style of man is being rapidly eliminated from the army and navy. There certainly should be no place for him in the accepted scheme for the reorganization of the Navy Department.

It would be far better to have but one class, one corps of officers, to do all the kinds of work in the naval establishment, even including bone setting and soul mending, but that cannot be and at the same time have the sea officers of the line class up always to "best." So, at the point where the line officer is obliged to break off, to keep his sea efficiency intact, the staff corps begin. If this reasoning be sound, then any staff corps is precluded from taking upon itself duties that a sea officer of the line can perform without affecting his efficiency. This is an important point; it is hoped that the readers who aspire to be honest organizers will keep it in mind.

VII.

A debasing and retarding influence to-day, so far as progress toward efficient organization is concerned, is the personal differences between the line and the staff corps. Consider a little. Can there be any question between the line and the staff as to the virility—the manliness of their men? Turned into civilians to-

morrow and put into the various roads of endeavor that make up the day's work in the commercial world, would there be any difference in their standing as manly fellows? No. Again, taking the two classes of officers as they stand to-day in the service, can there be any difference, as classes, in their social antecedents? Also, there is but one answer to this. Yet again, because the line officers have graduated at Annapolis, does that fact give them a title of superiority in their official work with their comrades of the staff? The answer to this is, no superiority, but a naval advantage, which is important. (It would be well if all the officers, including the doctors and chaplains, came from Annapolis.) Some think that because the navy is maintained for war purposes, one must be warring all the time in and about it. Let them take model from the New York police force, composed of the most peaceable men on the face of the earth, mild and gentle as doves in their magnificent discipline, while perfect men of war when the time comes to "close in." The immortal Washington when he said, "In time of peace prepare for war," did not mean that every patriotic citizen should chew off his neighbor's ear in the morning, knock in a row of his teeth at noon, and at night, in order to be prepared should war come early next morning, kick in a few of his ribs. He meant only plenty of guns, powder and sense.

VIII.

The sea officer of the line should have nothing to do with the procuring or keeping supplies in store, and the accounting for value, except as "senior officer present." Also, he should have nothing to do with the industrial shop work in the establishment. To-day, he has; many asserting that he should have control of it. He should have no more to do with these things than with the interior management of the naval hospitals. Would the control of these matters make him a more efficient officer to navigate, gun, and perhaps fight with the fleet? No. Would this control on his part add to the efficiency of the shore establishment? On the contrary, it would detract from it by taking control from the hands of those more capable by training, and who have *all* their time for the work. A sea officer of the line, in a position on shore in the industrial part of the establishment, is a sin against the fleet, if all his mental effort, all his official hours and all his ambition are expended on the duties of the shore office he temporarily holds;

and yet, if it is not so, a sin is being committed against the industrial and commercial part of the naval establishment. So the present situation is bound to be bad either way; false in its inception and false in its present day practice. What would be thought of a custom that permitted naval constructors to go off for two years or so at a time and practice dentistry, or become politicians? Where then would efficiency and economy in the department of ship design, construction and repair come in? Yet there are dozens of active line officers doing duty to-day that fits them in no way for the ultimate position of a directing force in the fleet,—in positions where, if doing their full duty there, they have no time to think even of rope yarn, let alone fire control, temperature of magazines, international law as applied to revolutionists, fleet tactics, and so on. And the poor sun has but hot golden tears to weep; the cold moon to wrap itself in icy reserve; and the twinkling stars to twinkle out their tiny existence afar, as they see the cobwebs growing over the sextant box and hear no longer the tick of the run-down chronometer of the embryo battle-ship captain or admiral, who hums a landlubber's song as he supervises the cleaning up of the streets of a navy yard, or fights a battle royal with a wily contractor over horse shoe nails or sewing thread, or writes postal cards to a batch of laborers to "come in to-morrow" and take a job on the new sewer. It is not meant that the sea officer of the line should never be on shore; far from it. Nor should that officer be blamed for accepting any duty that he may obtain, if there are not sufficient legitimate shore billets to go round. The system that places him in such positions as secretary of the Board of Labor Employment or head of the Board of Inspection of Supplies at a navy yard, is to be blamed. His shore duty should always be connected with his sea profession, so directly and fully, that in the conscientious performance of it, he will not detract from the efficiency of any part of the naval establishment, and will not unfit himself in any way for an active sea officer of the line. Better keep him on no particular duty, on full pay and allowances, during his rest periods from the sea, than to employ him at duties mentioned. A sea officer of rank should be appointed to every modern ship placed out of commission, as care-taker and superintendent of repairs, to remain by it until again commissioned. Good and useful shore duty this would be. (It is not meant that officers should live on board such ships.) These superintendents should

have the privilege of communicating directly with the bureau of the fleet, or any other bureau, to the same extent that heads of navy yard departments now do.

IX.

Greatly to be regretted is the desire shown often by some sea officers of the line to take unto themselves duties on shore that are foreign to their calling as naval seamen; and at times, acting in concert, a disposition to invade the precincts of the industrial part of the naval establishment, with the apparent intention of learning the language and driving the present incumbents out. This attitude detracts materially from the efficiency of the fleet, causes friction and adds to the general expense. Not a thousand years ago, a portion of the force of a small aggregation of large men, sea officers of the line, was wasted for a time in trying to gather information about something that did not concern them as seamen; and anyway the information could have been obtained from a certain "staff" bureau for the asking. Instead, time and money were wasted, and the writer believes, from examination of memoranda on the subject, little but delusion was accomplished. But the main thing was that it was not the duty of those gentlemen to try to collect the information, when there were trained, trustworthy men being paid good salaries to do it.

Another time, a sea-gull of a line officer, flying over a staff bureau, happened to drop inadvertently on its shores a certain document. This paper expressed the desire to have line officers appointed in war times as masters (or some such title) of transportation of supplies, in connection with fleets, a position that the man-in-the-street would say should belong to a seagoing officer of the staff corps, who had had experience in the matter in time of peace, and who had been receiving his salary for that particular line of work. By the way, to keep this paper from getting too dry: The document dropped stated that in case of the approval of the master of transportation scheme, it would be well for the Department to keep in mind that to make the master (or whatever he was called) thoroughly efficient, he should be appointed to his post at least six months each time before a war broke out. A shore buzzard of a staff officer, roosting near by, suggested that the staff bureau heartily approve of the recommendation, provided the clause about the six months be scrupulously adhered to. Why

does a commander or a captain want to be a master of transportation of supplies in time of war, with the magnificent openings to immortal glory before him? The writer would rather be the captain of a first-class battle-ship than once President of the United States, and he would rather be the admiral of a first-class fleet than thrice President. The masters of transportation should be obtained by a proprietary requisition, upon the Paymaster General, for officers of the supplies and accounts department, with a certificate that those articles and no others will answer the requirements of the service.

From the time he locks his sea chest and goes over the side for the beach, until he joins the fleet again, the line officer should box the compass every morning and in the evening recite the Rules of the Road, singing between times, as the clock strikes the hour, a verse about the sea and its kind, to remind himself that there is a line from the fleet bent on him which at any moment may yank him back.

> Where the lopping waves dash up their salty spray
> And the smudge of the sea fog covers the sailor's way.

X.

It is not asserted that many line officers are not competent to perform certain duties in the industrial and commercial branch of the naval establishment. The point is that they have no time to touch these duties if they are to rate as "best" in their profession as sea officers, in this day of the battle-ship fleets. There is an example now of a seaman who is performing wonders, comparatively speaking, in the industrial and commercial world of the navy, but this is no argument for the future control of such matters by line officers. In the first place, the field for this work of improvement at the navy yards is large and so open to all comers, owing to the urgency of the case, that many could till to advantage in it; in the second place, the officer referred to has particularly inherent talents for such work. With his acutely intelligent mind for the doing of concrete things, with few preliminaries, and his refreshing fearlessness in going about the tasks, he is as well equipped for an industrial captain as for a lord of the deep. After all, it might be said by the ordinary looker-on that his principal work so far has been that of forcing coordination, which later on will not be necessary. Coordination in the navy is somewhat of an acquired taste,

and the first mouthfuls of it are generally swallowed after the nose of the unwilling subject has been held by the doctor. By and by, be he really of the timber the navy wants in its personnel, he will eat the doses of coordination out of the Department's hand.

XI.

The control of the industrial and commercial forces of the naval establishment is next in importance to that of the fleet, considered as a completed element, ready for service. If these forces do not have their day in court in the work on the reorganization of the Department, the country will rue it. The writer feels certain that his comrades, the sea officers of the line, are on the wrong track when they seek to have control of these forces. Approval should not be given to a reorganization scheme where a fence is erected between the Secretary of the Navy and the industrial and commercial part of the naval establishment, with the gates in charge of sea officers of the line, for those officers would not be competent, at all times, to open them when they should be opened, to allow the directive forces of the industrial and commercial part of the establishment to pass through to the Secretary.

Who says the vexed problem of Navy Department reorganization will be solved by the appointment of three admirals or twenty admirals, or admirals, captains and commanders mixed, to control all, under the direction of the Secretary? This is what is seriously proposed. The question of battle-ship design will not be the only one to be passed on; there will be thousands of others, and of these, hundreds that they will know nothing about. How will the naval establishment be affected by their final handling of these latter cases? Then, after they have passed on the questions, hatched out ducks instead of chickens, will they be better commanders of battle-ships and fleets for the doing of it? Such reorganizers would make these sea-officer controllers masters of all trades, after they had served an apprenticeship in but one. They would form them into a Chinese wall around the Secretary of the Navy, within the protection of which that official would be the invisible man of mystery to the industrial and commercial part of the naval establishment. There, lolling away his official existence, drowsy with the narcotic of military fame and pomp (an influence with nearly every one of us), he would be entertained by chants of homage and the tales of the story-teller.

There is no economy, and there is certain to be death to extreme efficiency, in useless subordination of gentlemen of skilled training, of fine edge, and of patriotic ambition. Such men have the intelligence that sees the necessity for the common subordination called for, so the machinery of the whole may move in a way to do its expected work; but that intelligence will also tell them immediately when the subordination exacted of them is unnecessary. Then destruction of valuable assets of to-day will begin. The skill will no longer be used to its full power; the fineness of the edge will be destroyed by the rust of indifference; and ambition will be laid away with other dead things of a disappointed life. Do not answer that they must do their duty fully wherever placed, but say, instead, that they should try to do it. The former would be something like the street corn doctor in New Orleans who hired a negro to sit in the chair in intervals between real customers, to attract the crowd, and then abused him because he didn't smile every time the doctor yelled "painless" to the crowd, as he sliced off a chunk of black toe and the darkey moaned, "Oh Lord!" Nothing but laughing gas could have made that black man smile. So with the unnecessary subordination of masterful men of skill and experience; it will also be necessary to give them laughing gas to make them smile. Do not insist on the impossible in the hope of making an impression. All that is left often after such unwise policy is a hole in the ground. A hundred years ago there was a captain of fiction who fought in the Peninsular War. He never could get his legs to carry him far enough in a charge against the enemy. Finally he hit upon the expedient of detailing two privates to do the carrying, and thereafter, in their arms, he found no difficulty in reaching the cannon's mouth, while he waved his sword and called out to his brave men to follow. In that case it would have been folly for anyone to have insisted on the captain's legs going it alone, for if any influence could have made them, it would have been the captain's. That would have been insisting on the impossible.

Men's reputations, hearts, and futures are not like public dollars. While some of the zealous reformers might not care what the cost of the change in money was to the government, they should have a care as to how many ruined professional lives they are going to leave behind as they club their way to success. In time of peace, prepare for war, certainly, but in that preparation do not leave the

field strewn with a worse carnage than war could cause. These officers of the industrial and commercial part of the establishment who are being treated rather as dross at the moment, in some plans, are American citizens of the finest calibre. Do not ride rough shod over human beings; if you have to ride, ride round them. Take the pay corps: After years of struggle and gigantic endeavor on the part of the leaders of the work therein, it has attained a place that one can envy, and it is still going on toward the goal of perfection. By its labors, the efficiency and comfort of the entire service has been advanced in such a way as to bring forth unstinted praise. According to the "changers" it is now time for it to pack up its belongings and move from the front of the house to the servants' quarters in the rear.

What the writer would like to see before anything radical is done would be the stationing of sea officers of the line in the various bureaus for two months, these officers selected perferably from those who are quite dissatisfied with present conditions. Have one in the office of each bureau chief, to remain constantly by that chief during his work day, having the privilege of reading any paper that passes through the office. Change these students at the end of the first month so that each will have had experience in more than one bureau at the end of the time of study. When the time expires, have them submit individual reports of what they do not like and suggest remedies.

XII.

The navy is over a hundred years old. We should not need to do much copying in big things. There is no harm in copying some little things, such as, for instance, the wearing of gold aiguilettes by staff officers. This is a fashion, and fashions are always changing; next year they may be wearing them in the hair instead of on the bosom. Why go to Turkey or any other European state for a model for the new style of Navy Department? The governmental machinery is so different across the Atlantic, even where monarchy is limited by a stake and lariat. One country has an Admiralty Board, but that board rules a different organization from ours, although the output is the same—a fleet in readiness. In that country, practically all the work of the industrial and commercial part of its naval establishment is done by pure, unadulterated civilians, whose relation to the strictly military part of the

organization is different from anything here; and the relation of their Admiralty to the governing power of the state is different from any relation our Navy Department might hold to Congress. Yet there are persons who talk of settling the navy question by creating an Admiralty Board. What is an "Admiralty"? Why, a First Civil Lord, then the First, Second and Third Sea Lords and lastly a Junior Civil Lord. If we copied this, not having a House of Lords, but only one of Senators, it would be necessary to call our admiralty members as follows: First Shore Senator, First Sea Senator, Second Sea Senator, Third Sea Senator, and Junior Shore Senator. A bad point shows up at once; the Junior Shore Senator, now called Assistant Secretary of the Navy, would be under the three Sea Senators; he would not like that. The First Shore Senator would be what is now called the Secretary of the Navy. The First Sea Senator would be what is now called the Secretary of the Navy. There would also have to be a Secretary to the Admiralty, the wonderful man who signs the mail and reads the letters first, the controller of the waste paper basket; he would also be what is now called the Secretary of the Navy. The remaining admiralty senators would not be secretaries of the navy. They would be—well, the gentlemen who drew the pay of the Second and Third Sea Senators and the Junior Shore Senator, called for by the Budget (in guineas, please, if the House and Senate won't mind). The people of our country would hardly be able to digest such an organization, even with its pleasant Pepysine flavor.

XIII.

Before parting with this subject, of the officer-personnel, in connection with reorganization, it would be well to state that no reorganization scheme should be qualified by the numbers that are now existing in any grade of either line or the staff corps. The organizers should make up their minds as to the number that are needed in each grade to do the work that may be at hand. It is poor business to make laws that bring officers to a rank or grade at the proper age and then not have anything there for them to do, befitting the position. There should be no definitely fixed numbers for the line and the seagoing grades of the staff corps, but the law should permit of expansion or contraction according to the size of the fleet. The proper age in the different grades can always be

maintained by laws for voluntary or compulsory retirement. No reorganization will meet the demand of to-day unless it injects into the naval system a method of promotion by selection in both line and staff corps, from the lowest to the highest grades.

The writer believes in a plan, suggested some time ago, of officers entering the staff corps on probation of two years, with acting appointments, and if, after that period, they are to be retained, given commissions. He would add to this that the commission should be given upon the positive recommendation of the aspirant's commanding officers during the two years probation, and the chief of the bureau concerned. This would make it easier for those supervisory officers to do their full duty. If they did not believe in a young man they would remain silent, and it would end at that, which would be far better than the disagreeable task of making assertions of faults and shortcomings, and then having to prove them before a jury of "sea lawyers." It has been said that some officers now get "Good" on the semi-annual markings simply because their commanding officers do not care to go through the trials and tribulations that would follow a lower mark, finally arguing themselves into the belief that the officer in question may seem deficient to them while others would like him—especially the sea lawyers. The acting appointments of the staff officers should read that they are issued for the period of two years and at the expiration of that time the holders of them will consider themselves no longer officers of the navy, provided they are not at that time given regular commissions.

XIV.

The officer-personnel is not all. There is the enlisted man. It would seem that for years the main point in regard to getting the quality and quantity of the men that are needed has been missed, and that is, the starting point outside the navy in every case of the employment of men to do work for a wage. It is to consent to pay what the services are worth in the market. We in the navy cannot arbitrarily say what we will give per month for a gun man of the first class, this same being based on what we think he is worth, and then necessarily get the quality we want. We must pay what the stock is worth at the time of buying it, if we want that particular stock. The pay of all the enlisted men was increased the other day ten per centum. That is no way of doing it.

If a reorganization based on business principles is what is aimed at, and we want one thousand more first-class gun men, and we offer $30 and cannot get the quality, we should go on up, $35, $40, or even $100 if necessary, for the final aim is that the fleet class "best." In trying to do this there should be no driveling. When a certain quality of man's labor is worth $50 a month, with board and lodging, in the world's market, the navy should not expect to get a large quantity of it for $25 and try to make up the difference in other ways. A corporation builds a modern sky-scraper. Its basement is filled with a mass of first-class machinery to heat, light, and run the elevators. An engineer as boss of that basement is wanted. The corporation knows the kind of man they want calls for $150 a month. Thinking that is too much, they advertise stating that they will pay $100, but will give the engineer three dishes of ice cream a day. They will very likely get an engineer, but he will be only a $100 one, or at the best a $105 one, with an inordinate thirst for ice cream. And once installed, he will probably let a lot of electrical things burn out while he is eating the ice cream. The truth is, if the government will pay the price, it can always keep the battle-ships fully manned by the best quality of skilled and self-respecting Americans. Every decent man of intelligence in the country knows that a self-respecting enlisted man is treated in the navy as such a man is anywhere; these men will have no fear in signing articles of enlistment, as is shown now by the hundreds we already have with us. But it should be realized that trying to obtain the best quality at half price or by means of the voice of the soothsayer, is poor practice. From now on we should be practical and business-like. The days of sea romance and sentiment are gone, alas! Ships are no longer "shes"; they are now "its." At the beginning, naval men were roving pirates with permission to fly the flag and an obligation to fight for the flag of the country fitting them out; they wore then those delightful red silk kerchiefs around their heads for service dress. And to think that from this has evoluted the ward-room mess of to-day, dining in starched mess jackets and patent leather pumps off Hatteras in a gale. It was not many decades ago when, if the captain had hoisted the Jolly Roger when off soundings, every soul on board, down to the last galoot in the afterguard, would have acclaimed him their pirate king, as they made the sign of the gold doubloon with many a roaring oath. If

a captain did such a thing now, few would follow—perhaps the jack o' the dust, a sick bay nurse or two, and the ship's tailor. The crews have not changed; they have been changed. The old ones (God bless them!) have gone over the side forever with their bags and hammocks; in their places are the accomplished gun men of the modern battle-ships.

XV.

Some who advocate reorganization want to bring it about by violent death to the broad principles upon which the present organization of the Navy Department has rested so long. Having come to the conclusion that those principles will never die a natural death by reason of diseased organs (which speaks rather well for those same principles), they now stand ready to club them to death, in order to make way for their new structure. They seem not willing even to grant an honorable discharge to the old ones; they cannot wait for orderly progress to new—impatient time is knocking loudly at the door. The naval establishment needs reorganization, but it does not need it as badly as this. It needs it somewhat as a pussy needs catnip or a parrot a green pepper. But as without the catnip cure one should not get too near Tom's claws, or without the green pepper, flirt with Polly's beak, without reorganization, it would be well to beat to general quarters when getting near our navy.

There is a mistake made by many of condemning a whole system, or corporation, or such thing, on account of the person at the head of it for the time being. The writer has heard, more than once, the supplies and accounts system of the navy sent to kingdom come by some irate gentleman of the government's pay roll because a particular general storekeeper had crossed his official bows. It is well known that the convalescent officer patient when he is not given terrapin at a naval hospital leaves the institution damning the whole medical outfit of the service. Of course he should have had his terrapin, if it was an inherited taste, but the fact that the hospital failed in the matter just that once should not be the reason for the passing of the entire doctors' corps. To make this important point clearer, and bring the readers nearer home to the subject of the essay: Suppose there was in the Navy Department organization a Bureau of Navy Yarns, presided over say by old Admiral Spinner. Suppose

Spinner insisted on talking all the time and never listening. Of course such action would bring upon him the enmity of the Other Talkers. But should this state of affairs necessarily cause the obliteration of the Bureau of Navy Yarns? Not at all. The way to treat such an unbearable situation would be to retire Spinner in the next higher grade, and then let the Other Talkers choose one of their number for his place. By this diplomacy, the navy would still have the useful Bureau of Navy Yarns while Other Talkers would be rid of Chief Spinner for good.

XVI.

The Navy Department should be able to stand some reorganization without having its feelings hurt. Propriety whispers to the writer that he should not state what he thinks should not be of that now existing, but there is no reason why he should not say at least what there should be. In any plan there should certainly be a Bureau of the Fleet, where would be the field for the operation of all the directing forces of the line; one or more industrial bureaus; a Bureau of Supplies and Accounts; and a Bureau of Navy Health. These bureaus should have equal standing before the Secretary of the Navy and be subject to no orders from each other. In a properly administered Department, a disregarded "request" of one bureau to another would be a serious business, and too many such disregards would send a bureau chief back to where he should never have come from.

XVII.

As to navy yard reform, the Department is busy with that now to a telling degree, making such strides that it is believed that we do not need Nobody's Magazine or any other literary monitor to help in the work. (The writer is not casting stones at the magazines; he tries several of them nearly every month.) The consolidation of shops had to come. The readjustments on account of it have not yet been made in the orderly manner that could be wished, but that is coming. The five or six accounting offices at each yard should be consolidated. The Commandant of the New York yard is anxious to try this at once, and it is likely that he will be permitted to do so. There is a wide field in navy yard work for improvement in keeping account of costs and reporting the results in such shape as will be useful to the Department in

enforcing economy, and adding to efficiency, by comparing costs at different times at the same yard and those of similar effort at the different yards. This has been fully appreciated by the administration of the Assistant Secretary's office for some time past, and important pioneer work has already been done toward the improvements that will surely come soon. This reform will be one of the most important that will be made in the industrial part of the establishment.

The cost of manufactured articles of the same kind made at different times at the same navy yard, or at different yards, varies in a fantastic way. In this connection, the writer has a plan that might prove convincing and instructive; he would like to see it tried. For a limited time, say six months, at the New York yard, a large index card should be opened for each item manufactured by a yard department, with the date, quantity and unit cost. This initial entry should be followed by similar entries covering previous outputs of the same article during the preceding twelve months. The card should be headed with the name of the article, followed by clear and minute specifications. After these entries are made, the general storekeeper should record the quantity in stock and the amount issued *for use* during the preceding twelve months. The card should then be forwarded to the Department, via the other principal yards, where like entries should be made. After a lot of these cards had reached the Department, they would prove more interesting reading than a Sherlock Holmes detective story. They would have to be carefully handled, though, at the various yards to prevent confusion of dissimilar articles having the same name. They should not be placed in the hands of clerks like a certain one at a navy pay office who when he received a requisition for some porcelain shades for electric lamps, sent out blank proposals to makers of window shades. Or like one who, set at indexing a book, in which was the sentence, "John Brown had a great mind to oppose the passage of the bill," put in the index, "Brown, John, Great mind of...page..." It would interfere with the good work to have the prices and the quantities of fish boilers and steam launch boilers entered on the same card, or, say, drawing boards and wash boards.

The watch phrase the writer has recommended for a long time is: As many as possible of those doing things for the government to be paid by paymasters not in its employ. There is too much

done at the navy yards—much that should be done outside in the commercial world. This increases the pay rolls of the yards and the total number of persons in the employ of the government. The fewer public servants, the better off the country.

It has been whispered that the line officer commandants ought to go, when consolidation of shops, etc., is effected at all the yards, and in their places be substituted superintendents selected from the industrial branch. That is bad. There should always be a sea officer of the line in command of a navy yard. A yard's structure is not along the lines of the Navy Department proper, with the Secretary present as its head. The fact that there are almost constantly present at an important yard active units of the fleet, which often embrace a flag officer's ship, is reason enough for having the yards commanded as they are now, let alone several other excellent reasons not necessary to mention.

And right here for a few words about the New York yard. This is the one upon which all others should be modeled. It is head and shoulders above any other yard in importance, and it will remain so from necessity. It is likely the greatest naval supply depot in the world, considering the quantities of stores kept and shipped from there to other stations and to ships. There are facilities in New York City and its near surroundings that can be found nowhere else in our country. The yard has been cramped for years for lack of proper equipment in the way of buildings, the requisite amount of modern machinery, docks, and wharf room. The whole of the Cob Dock there should be given up to industrial and commercial purposes of the navy and the receiving ship outfit moved to Newport or League Island. Without affecting the industrial and commercial part of the naval establishment, League Island could be changed from a navy yard to principal barracks for enlisted men. The fine buildings there could easily be converted into dormitories and drill and recreation halls. All of the small navy yards and stations should be closed, but not sold; they could be put in charge of care-takers selected from worthy retired officers.

The arrangement of the important yards on the Atlantic coast is the necessary patchwork of a century of time. The New York yard would look very different could it be rebuilt to-day. Such a radical change cannot be made. But what can be done is this:

have model plans drawn up for the principal yards; have a copy of the plan in each office of the yard it concerns, also in each bureau and the office of the Assistant Secretary; and thereafter, whenever there is a contemplated alteration, new building, railway track, sewer, or after a big fire, etc., have a careful study made of the present plan and the model plan, with a hope of making a step, no matter how small, toward the ideal called for by the latter plan. Such action, conscientiously pursued, would make a visible impression in time.

One thing that will be needed in an up to date reorganization is a group of inspectors acting independently of any particular yard, who shall be engaged constantly in examining into the way the work is done at the industrial plants and the storehouse and accounting offices, and making certain that the Department's instructions are being observed.

XVIII.

What might be called the permanent civil personnel of the naval establishment should not be forgotten in any plan for reorganization. By this is meant the classified service. The Department is now doing all in its power to help this part, in the way of increasing salaries. But this large body of men, the majority of whom being faithful and valuable, is too apt to be forgotten in such work as this paper is discussing. It is strange, when one knows how the officers on shore work right with these men constantly, on the same problems, in such manner that often it is difficult to draw the line between the result of officer effort and that of civil clerk effort. This civil force must be maintained to a fine edge too, if the navy is to rate up to "best" at all times. This cannot be accomplished until a system of civil service pensions is established. Let us try to start this with the naval establishment reorganization.

XIX.

About the weakest point in the present organization, and it will be found to be the same weakest point in any reorganized department, is one that never shows in printed laws and regulations governing the navy: the improper influence of politicians in naval affairs. There is much talk about economy in the service, but to whom is it addressed? The people cannot help whether there is

economy or waste. And the real economy that might interest some naval officers is of no particular interest to many politicians. A large part of the waste of money connected with the navy is the fault of Congress and not of the navy. When we want to be true as economists, it must not be to Congress, or any other tangible power about us; but to an ideal—Our Country Glorified, an ideal above the sordid touch of the political gamester and the official trimmer.

Yes, Mr. "1st Citizen," "2d Citizen," or "3d Citizen," stalking up and down for the moment in Clamor's Court, the writer wants to say to you—and it does not matter whether you wear the badge of the scissors and paste pot or only that of the International Fixit Society of Boston—that you are to blame much more than any naval officer or Secretary of the Navy for present bad conditions in the way of expense. It was your hand that dropped into the ballot box the vote that sent to Congress a man who helped force on the service the care and expense of numerous naval stations that the navy never wanted, never needed, nor ever will. To make amends, go join the Naval League, to swell the membership to five million, and have the entrance oath to that league read: "I hereby solemnly swear that I will never vote for congressman or senator who has previously meddled in naval affairs beyond the legitimate work connected with the appropriation and other naval bills." Five million American voters keeping such oath would settle this part of the question. There would then be an end to those letters, written on Capitol stationery, to the bureau chiefs and the Secretary; letters that read inoffensively enough to the office boy, but which, when held up to the light, blazon out, between the lines, the peremptory command, "*Do it!*"

XX.

In this reform work the navy had better go into the public forum itself, if possible, and depend little upon the professional news writer taking up the cudgels for the sake of attracting the people's influence for the cause. In farming out the work there is danger of giving the public a false, limited, or exaggerated view of the case in order to have the attention of the surfeited magazine reader. Once upon a time, a peculiar case came under the writer's notice. An accomplished writer for the public prints re-

ceived an order for an article about navy reorganization. He gathered his data under what seemed most favorable circumstances. He was told many things by a number of important persons. But when about to exile himself with his typewriter, he, safely introduced, dropped in on a Last Person, for a few words about ledger accounts or some such things that had not been included in the curriculum of the aforesaid important persons. After a few dry exchanges, both feeling their way, the Literary Man began to wax familiar with the Last Person, and then after the Last Person had announced his platform, they were off on a long, interesting talk. The Last Person was charmed by the earnestness of the amiable gentleman confronting him and amazed at the fund of technical knowledge he had acquired in so short a time; but as a tragedy so often follows a charming, there was a dire end. The Literary Man finally said something like this: "Do you not think one of the chief causes of the irritating independence and arrogance at times on the part of bureau chiefs has been the knowledge that they were appointed and confirmed for four years and could not be removed before the expiration of that period?" The Last Person explained that such a nailed-down tenure of office was not a fact for those much abused gentlemen at the head of the Navy Department bureaus; that if the Secretary of the Navy asked any one of them to resign his office, the request would be complied with immediately, a thing that had happened several times. The Literary Man looked incredulous. The Last Person then explained that the military training of the chiefs of bureaus, their sense of necessary subordination, would keep them from hesitating on account of their four years lease. This drum and fife explanation seemed to tell for a moment, and then a steely light of thrust and no parry came into the Literary Man's eye as he replied, "But the chiefs of the staff bureaus, they are not officers, and therefore would not have that delicate sense of blind obedience; they might refuse to go." This man, of the first class, was about to launch upon the country a literary diatribe on why the naval establishment needed reorganization at once, and, apparently, he believed he had collected from experts all the data necessary to make his work effective. Maybe, in one sense. The Last Person could not blame the scribe, but he is still wondering who was to blame for the spectacles he was wearing.

XXI.

The forum that the Naval Institute has maintained for the navy for thirty-five years has been a mighty blessing; but things are becoming so strenuous now-a-days that although the published articles have the same voice they have always had, the "discussions" of those articles, published afterwards, are sometimes stale, owing to what has happened between two quarterly publications. There should be a branch forum in the Department at Washington, and there, twice a month, with the Secretary and the Assistant Secretary, could be talks on matters of moment, with all officers allowed to participate, within reason. This would accomplish much in a short time. (The silence of the tongue of one intelligent man in a free country is more harmful than the braying of a hundred donkeys in public life.) Meetings could be in charge of a forum committee, say the Judge Advocate General, the Secretary of the Naval Institute, and the Librarian of the Department; any one of these could preside. In the forum would hang a slate, and on that, without formality, any officer could inscribe or have inscribed his wish to tell something about a certain matter, or criticize some other's ideas, at the next meeting. There are officers who would come many miles, at their own expense, to attend in such a forum. To repeat, the good of this would be remarkable in a short time. *Everybody would learn.* Everything said would be recorded. After each session the forum committee would censor and edit the record and then pass it to the Secretary, via the Assistant Secretary, for further editing and elimination, if necessary. It could then be published in the next Proceedings of the Institute; not in the daily press. The sessions in the forum should have the dignity of honest earnestness, and he who loves first of all to see his name in the papers should not pass in under its arches. "A naval officer of high rank," as the newspapers say, who participated in the recent conference at Newport, told the writer something as follows: That what seemed to him the most remarkable thing of that experience was the influence the arguments had on the members. He said he had seen stubborn men change their minds there under the telling words of some comrade; at times, though, in two or more hops, where extra stubbornness would not allow of it at one long jump. He said that he had not believed before that he himself could be influenced to such a de-

gree as he was, when he had that rare opportunity of meeting his brothers face to face in real debate.

XXII.

As to starting in on the reorganization of the Navy Department and the whole of the naval establishment, the writer has only to say:

Go; go at once; but go slowly and you will get there well before the Hare. Be calm. No revolution is necessary. Weigh things not on biased scales but on those of worth and justice to all elements concerned, so the whole may have the proper quantity of each necessary quality. The writer would also remind his comrades not to forget the need of following, in this grand work of making the nation's naval establishment better, the teachings that everyone has received at least in his youth; the teachings that can never be forgotten, no matter what has crowded into life in maturer years, because those teachings were of the only indestructible thing—TRUTH. In going at this problem of reorganization, or at each other for that matter, in connection therewith, if there be fair disagreement, cast out from hearts all consuming wrath and despise.

Nisi Dominus, frustra. Or as the man who wrote Barrack Room Ballads and created Mowgli and Little Toomai puts it:

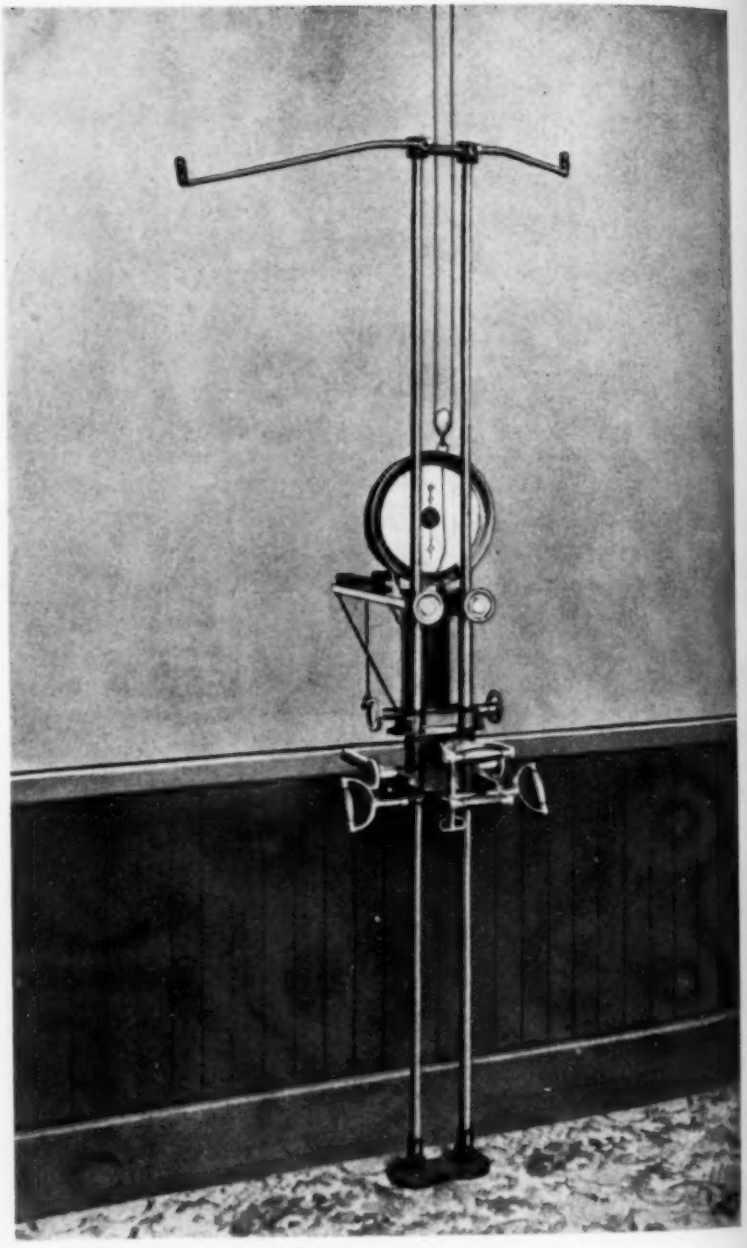
God of our fathers, known of old
  Lord of our far-flung battle line,
Beneath whose awful hand we hold
  Dominion over palm and pine;
    Lord, God of Hosts, be with us yet,
    Lest we forget! Lest we forget!

The tumult and the shouting dies,
  The captains and the kings depart;
Still stands thine ancient sacrifice,
  An humble and a contrite heart.
    Lord, God of Hosts, be with us yet,
    Lest we forget! Lest we forget!

Far call'd our navies melt away,
  On dune and headland sinks the fire,
Lo, all our pomp of yesterday
  Is one with Nineveh and Tyre.
    Judge of the nations, spare us yet,
    Lest we forget! Lest we forget!

If drunk with sight of power we loose
  Wild tongues that have not Thee in awe,
Such boastings as the Gentiles use,
  Or lesser breeds without the law,
    Lord, God of Hosts, be with us yet,
    Lest we forget! Lest we forget!

For heathen heart that puts her trust
  In reeking tube and iron shard,
All valiant dust that builds on dust,
  And, guarding, calls not Thee to guard,
    For frantic boast and foolish word,
    Thy mercy on Thy people, Lord.



THE UNIVERSAL DYNAMOMETER.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

HONORABLE MENTION.

A PLEA FOR PHYSICAL TRAINING IN THE NAVY.

By COMMANDER A. P. NIBLACK, U. S. Navy.

Motto: "Know thyself."

There is no question but that the physical examination for entering the navy, for promotion, and for re-enlistment, certifies to a reasonably sound body and a theoretically perfect physical condition, but the physical exercise which each officer and enlisted man gets in the discharge of his daily duties may be very much or very little. With any proposition to introduce compulsory gymnastics or physical training in the navy, it is this phase of the question which should be considered. The theory of the navy's existence in a state of preparedness for war is based, for one thing, on the assumption of the practically perfect physical condition of the personnel, so that a physical test of officers is one of the theoretical sequences of this proposition; but it is very important to consider in how far life on board ship may be regulated so that this mere theory may become a reasonable and wholesome fact.

This brings us fairly up to the question of athletics, either as voluntary or as a compulsory adjunct of what exercise the daily performance of duties may entail physically. There is a popular idea that the days of sailing ships bred giants. There is a good reason why it did not, and the principal one is that the diet of the crew was not very much, and the officers did not go aloft any more than they do now. It is probable that the physical average of the officers and crew of the average ship in the navy to-day is very much better than it formerly was, even with the cigarette habit, as at present, a recognized handicap to physical endurance, which it distinctly is. There is a popular idea also that people on shore can get any amount of exercise, can frequent gym-

nasiums, and take up every form of out-of-door sports; and that, on the other hand, life on board ship is cramped, that no opportunity offers for exercise, and that the seafaring portion of the navy is at a serious disadvantage as regards keeping in physical training. That this idea, as far as it concerns the navy, is not necessarily justified is one of the propositions which the writer wishes to demonstrate.

Leaving aside all questions of physical tests, of whether any system of physical training in the navy should be voluntary or compulsory, and calmly ignoring the daily rumors in the newspapers as to how old one must not be to expect anything pleasant whatever, let us consider the general question of athletics *on board ship*, athletics being assumed to embrace all forms of physical exercise deliberately undertaken for the sole purpose of physical development.

If we turn to the literature of athletics and physical training, we find it not very considerable in amount, nor satisfying in the definiteness of its conclusions, because there are fads and fancies in these as in many other things. One thing, however, is clear. Athletes pretty generally scoff at book athletics, and theory is heavily discounted. It is a curious fact, however, that the people who converse most about "practical athletics" have often the most to learn from theories. As one who has wandered afield in the general subject of athletics principally as a means of health through exercise, and with no definite knowledge in those branches which qualify one as an M. D., the writer, as one truly interested in athletics, wishes to present a point of view which is as unique as it is lonesome.

A man may get physical development the way he gets gold out of a mine—by working for it; but the fact remains that all real physical strength and endurance rest on the foundation of a proper diet. It is in the question of diet that we are on the eve of witnessing great changes in prevalent ideas. Nor is this a mere statement. It is a fact. The chemical analysis of foods, bacteriological research, and laboratory experiments, in conjunction with the scientific study of dietetics, have brought to light certain facts which will ultimately work great changes in our prevalent ideas, particularly in diet as an adjunct of training for athletic contests where *endurance* is a factor. We train athletes now very much as we train race horses, through methods and customs founded on

experience and handed down from one trainer to another. Our ideas on gymnasium work and physical training have been developed along very much the same lines, but we are on the eve of witnessing a great change in this also.

Athletics at our large colleges, not excepting the Military and Naval Academies, consists largely of foot-ball, with base-ball in season, and with track meets, shell races, lacrosse, fencing, basket-ball, glee clubs, tennis, golf, and gymnasium teams, etc., exciting a mild interest. The total of the number of the members of the various teams does not as a rule amount to one fourth of the student body. The other three quarters look on and meanwhile miss the chance for physical exercise which they themselves need. Indeed, it would be an excellent plan in most colleges, particularly in government schools, to not permit students who are themselves deficient in physical development to witness anything but an occasional game or contest, the time being put in on making up their deficiencies. The net result now is that the costly buildings and apparatus attached to most of the up-to-date schools, under the name of gymnasiums, are patronized principally by those who need the exercise the least. The whole tendency of college athletics is to develop a few stars, or a few abnormal prize-winners, and not to bring up the average by lifting the deficient, but rather by pulling up the top ones. In government schools the principle should certainly be reversed, not only as a protection to the pension and retired lists, but on the principle of realizing the longest and best service out of persons on whom years of training and much money have been spent.

All-around physical development unquestionably is a necessity in most athletic contests, especially those between teams, yet some athletes themselves, who go into gymnasiums to train for field work, have none too definite an idea of what line of work they should do to accomplish a given result, because the end and aim of most gymnasiums is along the line of teaching "stunts" and feats of strength. This is shown by the fact that in gymnasium contests the scoring is all by how difficult the feat is, anything short of a rupture counting heavily. Of course grace counts for a great deal, but grace is merely strength controlled within safe limits. The whole idea is wrong and discourages the proper use of gymnasiums. In studies the whole idea is not to develop one or two Sir Isaac Newtons. They will develop themselves. In

the same way a system which aims to give all-around physical development to all its pupils will incidentally develop all the "stars" needed. They will come forward naturally.

Before discussing the various systems or methods of physical training, both with and without mechanical appliances, it is interesting to examine the question of standards of physical measurements whereby any one wishing to take up some form of exercise may compare himself with the average man of the same height, age, and weight. This not only excites interest, but is a rough guide as to the deficiencies which we should attempt to remedy. This measurement by the tape is a crude and out-of-date method as a guide to physical culture, but it has its interest in connection with training to a given weight, and is important as to matters of record.

PHYSICAL MEASUREMENTS.

A study of the physical requirements for entering the navy is suggestive as to weight and height.

In the case of minors, enlisting as apprentice seamen, the standard as to minimum weight has recently been raised, and is now as follows:

	Minimum Height.	Minimum Weight.
At 17 years of age.....	62 inches	115 lbs.
At 18 " " "	64 "	120 "
At 19 " " "	64 "	124 "
At 20 " " "	64 "	128 "

(A chest expansion of not less than 2 inches is required.)

The corresponding requirements for candidates for admission to the Naval Academy as midshipmen are as follows:

The height of candidates for admission not to be less than 5 feet 2 inches between the ages of 16 and 18 years, and not less than 5 feet and 4 inches between the ages of 18 and 20 years; and the minimum weight at 16 years shall be 105 pounds, with an increase of not less than 5 pounds for each additional year, or fraction of a year over one-half. Any marked deviation in the height and weight relative to the age of a candidate will add materially to the consideration for rejection.

During the last nine years at the Naval Academy (1899-1908):

		Years of Age.		Height.	Weight.
153	Midshipmen, age	15½ to 16½,	averaged about	66 inches,	126 lbs.
519	" "	16½ to 17½,	" "	66½ "	128 "
733	" "	17½ to 18½,	" "	67¾ "	136 "
1056	" "	18½ to 19½,	" "	68½ "	141 "

These matters of weight in relation to height are interesting only in the very important matter of training. There is no recognized rule in the athletic world as to what weight should correspond to a given height for a man in training. There was an old rule in vogue some years ago that adult persons should weigh at least two pounds for every inch of height, and not over 2½ pounds per inch. The gradual tendency is to raise the lower limit. Another rule for the ideal weight of any person of a given height is: "Subtract 42 from the total height in inches, and multiply the remainder by 5.5. The result is the weight in pounds."

As a matter of interest and to show the wide divergence of *ideas* as to the proper relation between height and weight, and in how far there is no really recognized standard, the following table gives some data as to adults:

Col. I gives the requirements for adults entering the navy. Taking it altogether it gives about the ideal weight for height.

Col. II gives the minimum weight according to the rule 2 pounds to the inch.

Col. III gives the maximum weight according to the rule 2½ pounds to the inch.

Col IV gives the weight (ideal) according to the rule "(Height −42) × 5.5."

Col. V gives the averages for fully developed muscular adults according to Dr. Anderson of Yale University.

Height. Inches.	Col. I. Navy requirements. Pounds.	Col. II. Min. Pounds.	Col. III. Max. Pounds.	Col. IV. Ideal. Pounds.	Col. V. Anderson. Pounds.
64	128	128	160	121	124
65	130	130	162	126	130
66	132	132	165	132	136
67	134	134	167	138	142
68	141	136	170	143	151
69	148	138	172	149	160
70	155	140	175	154	170
71	162	142	177	160	180
72	169	144	180	165	190
73	176	146	182	171	200

The navy standard as given in Col. I is, taking it altogether, the ideal average weight. That is to say, it is not founded on any rule or theory, but corresponds with actualities obtained by averages. The ten pounds variation allowed for recruits on examination is a concession to a man being under weight on account of

improper nourishment incident to hard times, or lack of employment. The average American man may be assumed to be 68 inches tall and to weigh 141 pounds.* All weights are of course net.

Every man not abnormally developed is supposed to reach with his arms, from tip of fingers to tip of same, exactly his height. The circumference of his chest is one-half his height. His calves, his neck, and his biceps (swelled) are the same in circumference. The chest expansion is over 2½ inches.

Incidental to the question of physical requirements for entering the navy, it may be mentioned that last year out of 81,442 applicants for enlistment, 29,919 were rejected physically and 26,242 for other causes. During the same period out of a total of about 40,000 men in the navy, 1098 were discharged for physical disability. At the Naval Academy out of 262 candidates who passed mentally in the year 1908, 51 were rejected physically.

THE VALUE OF PHYSICAL EXERCISE.

Training the body pays better than any other expenditure of time and money that one can make. Physical age depends very much less upon actual years than upon the care one takes of his physical machinery. One may be worn out at forty, and another vigorous at eighty. The secret of an active middle age and a vigorous old age is "exercise and elimination." This latter will be taken up as a separate question. The best stimulant and the safest is daily exercise, because persistent and methodical exercise eliminates from the part of the body exercised, the dead cells, worn-out tissues, and other clogging matter, bringing in a fresh supply of blood to build up and renew it. The alternate contraction and relaxation of muscles is the natural method of cleaning them of impurities. Exercise helps in the whole process of "elimination." One does not necessarily have to go into a gymnasium and perform a variety of violent motions at unpleasant hours to accomplish this result, for there are many means of exercising without employing mechanical appliances. A person 60 years of age, for instance, may, without apparatus, accomplish an amount of physical regeneration that is astounding simply by devoting

* Statistics show that the mean height of 315,620 native-born adult Americans was 67.672 inches, and the mean chest measurement 33.418 inches

time and energy to intelligent physical upbuilding. The possession of large muscles does not necessarily have a very marked effect on general health, but the use or exercise of muscles, whether large or small, does. In all questions of physical development, diet and elimination are the two other factors, besides exercise, which it is important to consider. For the moment we are dealing with exercise, and we will therefore consider muscle building as a fine art.

Exercise without Employing Mechanical Appliances.

(a) *Setting-up Exercise.*—We are all familiar with this form of exercise on board ship. While it has only a slight relation to muscle building, it is valuable in the contraction and relaxation of muscles, and it is at least a recognition that something of the kind is desirable. It offers, moreover, a very sound basis for a system capable of being expanded into something much better. It is too apt to degenerate into an uninteresting perfunctory performance. It is in this aspect that the enlisted force call it "monkey drill." Setting-up exercise is good as far as it goes, but it does not go very far.

(b) *Resistant Exercise.*—What is meant by this is the developing of the muscles by resisting with the muscle the effort to perform a given motion, as in the so-called Swaboda and other systems, which are merely variations of the great Japanese system of training, over two thousand five hundred years old. Imaginary weights and resistances are used, and while this may seem absurd to any one who has never tried it, the most astounding results are obtained. Men of very slight figure have built themselves up into powerful and pretentious-looking men solely by this system. It calls for the concentration of thought, or interest, on the particular muscle in use. It can be used, for instance, lying in bed; or in case an officer or man is a naval prisoner, in the hands of the enemy, this exercise can be used to keep the muscles in good condition in case a chance for escape offers, or in case of being exchanged with the opportunity to get back into active service.

This system has two inherent defects, but it is a thousand times better than doing nothing towards physical development. One defect is that mere muscle building does not necessarily produce endurance, and the other is that, by cultivating the resistance of muscles in conjunction with muscular action, it tends to produce sluggish and non-elastic muscles.

(c) *Self-Resistant Exercise.*—A method which overcomes one of the disadvantages, as above, is to as far as possible use the arms in resistance against the legs or trunk or neck by grasping the different parts and making one set of muscles work against another. This can be accomplished by lying down or may be done in bed, or sitting, or standing. For instance, the foot or leg or thigh may be flexed against the resistance offered by holding back with one hand or both hands. It is astounding what results may be obtained. Even people of fifty or sixty years of age may do wonders by this simple process persistently and methodically carried out. It, too, is a part of the Japanese system.

(d) *Dual Resistant Exercise.*—This may be defined as exercise by two people matching their strength in order to mutually develop different groups of muscles and increase their endurance by so graduating the work as to gradually prolong the struggle without injurious effects. This is, in effect, the basis of the Japanese system of training for *jiu jitsu.* It includes resistant exercises, and self-resistant exercises, as previously described, for preliminary or incidental training.

Primarily *jiu jitsu* is a defensive attack, so to speak. It literally means "muscle breaking." It teaches the means by which an antagonist of great size may be physically defeated by temporarily disabling him through paralyzing his muscles or nerve centers either by a clever blow or by finger or thumb pressure. The grip is rapidly and unerringly taken, and the stronger opponent is rendered powerless, because the more he struggles the more painful it becomes. It is therefore a disarming attack. An important part of the training is to harden the neck, body, and limbs by blows, by exercise, and by general toughening, so that the pupil is hardened against similar attacks by others. *Jiu jitsu* has no relation to Japanese wrestling. The knowledge of it was originally confined to the *samurai.* Now every soldier, sailor, and policeman is required to take a government course of it.

The Japanese possess the greatest endurance of any people on earth. They can undergo the effects of blows and physical strains that are incredible. This is all due to their diet, and to their physical training. The full course in *jiu jitsu* requires four years' time. Our ideas of *jiu jitsu* are very much what theirs are of fist-fighting, but what is valuable to us is the methods used in training, which are, for natural reasons, beyond all other systems the best.

The diet, deep breathing, resistant exercises, and bathing form a system which cannot be improved upon, and some modification of it is what should take the place of the setting-up drill on board ship.

The Japanese believe, for instance, that all strength rests on a foundation of a proper diet, and there is no way of getting away from this fundamental truth. Once a good healthy stomach is assured, the system is to develop the heart and lungs. For training the lungs deep breathing is taught. This is done in the open air, first by moving the diaphragm and abdominal muscles slowly but vigorously, the hands on the hips, and thus exercising for about ten minutes. Another method is to breathe in such fashion that the muscles just over the hips expand at the sides like bellows, while the shoulders do not rise with the effort. With the stomach right with a good diet, and lungs capable of full breathing, the heart is well along towards its capacity for hard work; but, in all exercises, in case of any undue uneasiness or strong palpitation of the heart, the student is required to lie flat on his back with arms at right angles to his sides and feet apart, until relieved, and for some little time afterwards. By such work and great care the heart is slowly and gradually strengthened, so that few tasks will trouble it in the least.

The dual resistant exercises, as practiced by the Japanese, consist in opposing wrist to wrist, or forearm to forearm, or elbow to elbow, or shoulder to shoulder, or leg to leg, or calf to calf, or ankle to ankle, or chest to chest, or back to back, or lying down to press foot against foot, and by gradual pressure and muscular exertion to defeat one another. In the early stages no attention is given to victory, but merely to training the muscles. For this purpose a stronger antagonist gradually gives way to a weaker. The work progresses gradually, from day to day, and in no case is the heart allowed to be overtaxed to the point of severe palpitation. The keynote of all Japanese contests is good nature, dignity, and calmness. These resistant exercises are practicable, admirable, and, as previously stated, should either take the place of setting-up drill on board ship, or be supplemental to it.

With regard to the use of water, the Japanese drink it freely, and bathe frequently, even two or three times a day. Fresh air and rest are also required features of their training.

The Japanese system is practically the basis of all so-called re-

sistant systems which appear under the names of various individuals in this country and claiming to be original, whereas *jiu jitsu*, which employs them all, is, as previously stated, more than two thousand five hundred years old. If parts of the system can accomplish such results as are shown, then the complete system must stand at the head of all methods of training without the use of mechanical appliances.

GYMNASIUM METHODS.

Gymnasiums are here assumed to use purely mechanical means in the development of muscles. As fitted out and generally managed in the United States to-day, gymnasiums fail in their full purpose through a failure to realize their true mission and purpose. All gymnasiums consist of a lot of apparatus or machines up against the walls, and numbers of others away from the walls, such as horizontal bars, flying rings, parallel bars, ladders, side horses, vaulting horses or bucks, punching bags, dumb-bells, Indian clubs, etc. It is a very curious thing that the instructors usually employed in gymnasiums can instruct in feats of strength, and are thoroughly familiar with all the machines other than those against the walls. Even the athletes who frequent the gymnasiums do very little business on the "side line," so to speak. In fact the whole "business" of the average gymnasium is in other than the wall machines, while, on the other hand, the position here taken is that the real "business" is practically on the side lines, using the word "business" in the sense of an investment with a view to getting adequate returns. To be specific, nearly all gymnasiums are mismanaged, and they are frequented by people who need them least, and are not frequented by those who need them most, and this is because the system or idea on which they are conducted is wrong.

To show this, let any number of either novices or people who have had pervious experience in gymnasiums, but not recently, stroll into a gymnasium. The first thing they do is to weigh themselves, then hit the punching bag, and instantly undertake some "stunt" or feat of strength which is just beyond their real powers. It is so easy to get harm out of a visit to a gymnasium that it is wonderful that so much money is forthcoming to build all there are. Every one is after the short cut to physical development, and few have the patience to begin where they belong—at the begin-

ning—and work up. On the other hand the people who criticize gymnasiums by saying that they believe in exercise out of doors, or that the easy things are tiresome, or the mere development of muscle has no relation to health, are simply people who do not take exercise anyhow, as a rule, and are trying to justify their inaction.

Between the two extremes of abuse of gymnasiums, both by word and by misuse, stands out the fact that there is almost no limit to the physical improvement *anyone* can get out of the ordinary gymnasium through the guidance of a trained instructor who uses a testing machine as his guide to proper exercise. The progress anyone can make in even one month by less than one hour's work a day is so considerable that there is no other investment of time one can make that can be compared with it, and in six months one can pull oneself out of a condition of flabby discontent by the expenditure of less time than is usually spent in lamenting it.

There is one particular testing machine on the market which can convert any ordinary gymnasium into a scientific institution, and it is called the Universal Dynamometer. It is capable of testing the twenty groups of different right and left muscles and six trunk and neck muscles (or about 46 muscles or groups of muscles in all) in such a way that only the exact group of muscles in question is brought into play, the result being registered in pounds or kilogrammes on a dial by means of a needle, connected to a series of levers with a float which, under the action of the muscles, is forced into a cylinder of mercury. By testing many hundreds of people, a series of charts is obtained giving the characteristics of the average person of the same height. The various mechanical appliances in gymnasiums are numbered in such a way that any marked deficiency in all-around physical development may be remedied by working on one or more of the fifteen or sixteen machines which work the group of muscles found lacking in the test. This system therefore connects the gymnasium directly with the testing machine. You know just where you stand; what progress you are making; and you are getting just what you are working for. The whole thing is that the exercise must be gradual, and none of it must call for any form of exercise that will accelerate the pulse unduly, cause any heart distress, or in any way strain any muscle. Each day one tries one or two gentle movements on the rings or bars to lift the weight of the body with the arms (such as chinning

and dipping), but always being contented with less than one can do easily. In a very short time the general quiet work on the side wall machines will bring about the ability to gradually do more and more, easily and satisfactorily, and without distress or even fatigue. The best guide in working on machines is to start with very light weights and rely on the number of times a weight is lifted rather than on lifting a heavier weight fewer times. The test of how long to exercise is to work until the particular group of muscles "burn" a little or feel the exercise. There are special wall machines in all gymnasiums which may be used to build up the muscles of the legs, the arms, the neck, the trunk, the abdomen, the chest, the lungs, the ankles, the wrists, the feet, the fingers, or to harden the muscles for walking, running, or swimming, or for and definite feats of strength. Thus a gymnasium, rightly used, is a helpful auxiliary to athletics in general, but here we are considering it as a means of making *all* people athletes.

Gymnasium work on a machine is dull and tedious, but, under the system under discussion, the person tested gets a chart showing all the groups of muscles, and in how much he excels or falls below the average man of the same height. Under each group of muscles on the chart are the numbers corresponding to the machines to be used to develop the given group of muscles. The fact that he is deficient in certain particulars spurs his interest. The spirit of competition is also enlisted. He knows that, while he has deficiencies, by exercise on certain definite machines he can absolutely and certainly remedy the defects. It is not like taking a pill which may or may not accomplish the purpose intended. The person knows that by using certain machines he can get certain results. By using all the machines he knows he can raise his entire average. The athlete knows that he can keep in condition, and build up any deficiencies without fear of overdoing it or overtraining. This system is simple, scientific and unassailable. The testing machine furnishes its own prescription. Five minutes after the test, you can yourself work out the course to be pursued and you can, every once in a while, by a fresh test, find out what progress you are making. In a compulsory system the test takes the place of an examination. If any one has shirked, the chart shows it. This system, applied to a gymnasium, makes it an investment of capital drawing absolute interest, instead of a mere collection of apparatus, which few know how to properly use.

As one makes progress on the machines, and gradually gets strength to lift the weight of the body with the arms, on the horizontal bar, rings, or parallel bars, by chinning or dipping two or three times, then the ordinary instructor can take charge of the student and begin where he usually begins now in the absence of preliminary training. At this point it is the duty of the instructor to watch the heart during the work on the track, on the rings, or out in the circus department of the gymnasium.

The test of endurance, through building up the heart or lungs, is of course best made, in the open air, by running or hard tussling, or, indoors, by running, boxing, and work on the rings, ladders, and bars, which are good substitutes; although of course it is understood that diet is a larger factor in endurance than we are most of us willing to admit. It is of course admitted that it is best to exercise in the open air, but here we are only discussing indoor gymnasium methods. No one can for a moment deny that exercise out of doors is incalculably better than exercise indoors, or that the best training for out-of-door contests is to practice the form of contest out of doors. It is true, for instance, that the naval profession is really learned at sea, but this does not vitiate training on shore. In the same way gymnasium training is the basis for out-door work, but it does not take the place of it. It is merely a preliminary step.

The system here described has recently been put in operation at the Naval Academy, which is, as far as known, the only large college to use it. In a modified form it is capable of being introduced in the service on board ship. The necessary machines may be installed in waste spaces against bulkheads, and a testing machine put in the sick bay at a total cost of less than $500 in each ship. If the army can afford to buy 500 "messenger horses" with a view to encouraging polo, the navy can certainly afford to introduce physical training on board ship, on a scientific basis. If taken up as a part of the routine drills, it would increase the physical development of the officers and crew from 30 to 50 per cent in the first year. If left to mere voluntary effort, without a system, the machines would be left to rust and would soon reach the scrap heap. We have seen a revolution brought about in the gunnery by the Morris tube and the dotter. The system of athletic training here described is quite as revolutionary and as far-reaching in gymnasium methods.

STRENGTH TESTS.

As explained, the real object of a testing machine is to get a "prescription for exercise" in the gymnasium. The machine in question is so cleverly arranged that the group of muscles tested is isolated from the possible action of other groups. The result is given in kilogrammes or pounds for each group, and adding these together gives the total strength of the entire body. The groups of muscles are classified under arms, legs, trunk, and chest. No person is ever found whose chart gives a perfectly straight line. The curve is generally a zig-zag line which graphically indicates variations above and below the average or normal. A "prescription for exercise" can be made out from this in a few moments, which will be more perfectly adapted to the needs of the individual examined than can be arrived at by most elaborate study based on any other methods. A tape line may give the dimensions of the body and limbs, but there is nothing to indicate that the person from whom the dimensions were taken is dead or alive. The record taken in a testing machine shows the person's muscular capacity for work. To judge by tape measurements as to how much work a person can do would be simply to guess.

The strongest group of muscles is, of course, the back. The strongest single group of muscles is the foot extensors, which are the muscles by which a person rises on the toes. The average person can with one foot thus lift nearly 250 pounds. While we know that smaller people can often physically overcome larger ones in a contest, yet when it comes to the total strength of all the muscles of the body, it will be found unfair to compare anyone with another whose height is not approximately the same, for the reason that the height depends upon bone development, and the law of development connects large muscles with large bones. A comparative test of tall men and short men will show that at nearly every point the tall man is the stronger. It is also true that the difference between the height of tall men and short men is chiefly in the greater proportional differences in the length of the legs. A study of a physical chart, made from the averages of fifteen hundred men of all conditions, shows the remarkable fact that while, as between men of from 64 to 72 inches in height, the total strength in hundred-pound units is, for the entire body, in the ratio of 36 to 48 units, this total is made up of from 2 to 3 units for the strength of chest, of from 7 to 8 units for the trunk, of

from 11 to 15 units for the arms, and of from 15 to 20 units for the legs. This leads up to the statement that the difference between tall and short people is largely in the strength and length of the legs, and that the total strength of the average man varies nearly as the square of his height in inches. The strength of the arms as well as the legs figures largely in the total, and a moment's reflection will show us that, in athletic contests, the strength of the legs and arms is, aside from that of endurance, the principal factor. The trunk and chest count about in the ratio shown by the testing machine. On the other hand, the most important work as affecting the general health is work or exercise which is put in on the chest or trunk. The inference is plain, that for athletics and general health all-around physical development is desirable. If any one is inclined to resent the fact that the testing machine shows that the total strength of the average man varies nearly as the square of the height in inches, it can only be pleaded in extenuation that it is not the fault of the machine, and that shorter people, if they feel badly about it, have their revenge in cultivating their legs and arms. As a matter of fact the only purpose of a testing machine is as a guide to exercise, and not as a cause for dissensions, which is too often what athletics as a subject of discussion drifts into. Debate seldom incites any one to better his physical condition.

Diet.

Very few people are interested in diet. Moreover it is a complicated and very unsatisfactory question to discuss, being full of pitfalls for the unwary, fads for the partially informed, and endless argument for every one. It is, however, important to sick people, and also to athletes in training. It therefore ought to be important between these two extremes, and as we are discussing physical training, and as the Japanese regard the stomach as the seat of endurance, it may be that an amateur discussion on this dangerous subject may prove diverting, if not instructive.

We live not upon what we eat but upon what we assimilate. We cannot assimilate anything that is not digested. Regarding, for a moment, the body as a boiler being tested for efficiency, we know that it is only the fuel which is converted into heat which counts. Too much coal, or too little coal; poor coal, or good coal mixed with foreign substances affect the efficiency. What drops through the grate bars unconsumed, or as ash, plays no part in

developing horsepower, and may retard it. Too much food, or poor food, or good food mixed with unnutritious material will certainly interfere with efficiency, but food is something more than fuel. It supplies not only heat and energy to the body but also tissue-building material. And thereby hangs all the question which is now troubling the medical world in the question of diet, viz., the tissue-building material. Is meat essential as food for tissue-building?

We all know that the body is composed of chemical substances similar to those of the foods we eat. The principal compounds which concern us in both the body and the food are the proteids, fats, carbohydrates, mineral matters, and water. The refuse and water in foods are non-nutrient, and they form a very large per cent in many of them; but, as water contributes over 60 per cent of the weight of the average man (although it cannot be burned and hence does not yield energy), it is a very important constituent. In a general way, the fats, starch, sugar, and fruit acids supply the body with heat and muscular energy, while the proteids (which comprise the lean of meat, the white of eggs, the gluten of wheat, the casein of milk, and the vegetable casein of peas and beans, and similar food-stuffs) are the tissue-building element. The protein or nitrogenous compounds form about 18 per cent of the weight of the average man, and the fats furnish about 15 per cent. The fats, which furnish the most of the fuel, come from animal foods, but are found also in nuts, oils, fruits, and cereals. The carbohydrates form only a very small proportion of the body tissues (less than 1 per cent) but furnish fuel. Mineral matters, though yielding little energy, and forming only 5 to 6 per cent of the weight, are indispensable. There is a curious side-light thrown on this by the fact that the far Eastern peoples are supposed to subsist largely on rice, but if you should feed them on rice sold in the United States, they would soon starve, because it is all polished artificially before being offered for sale. The process of polishing carefully removes the mineral and other valuable compounds from the outside of the rice grains, and leaves only the starchy mass, which, though very white and attractive to the eye, is not the rice of the oriental.

Laboratory experiments, which are being conducted all over the world as to food and dietetics, have disclosed the means of separating tissue-building proteids of both flesh and vegetables, and

by artificial chemical means reproducing the various processes of the stomach and assimilative organs. The United States government has published the researches of Atwater and Bryan in "The Chemical Composition of American Food Materials," giving the proportion of proteids, fats, and carbohydrates (starch and sugars) in all the principal foods. The ration of food to give just the amount and kind required may be satisfactorily balanced. It has been demonstrated that a lesser diet increases bodily strength and endurance, and that the machinery of the body works more smoothly when less food is put into it. The waste materials of the body have been analyzed, weighed, and subjected to bacteriological analysis to such a degree that the toxic effect of undigested food, of meats, and of stimulants is absolutely known. The balance in the human body of intake and output has been again and again demonstrated. In the matter of dietetics, in relation to training, no one has done more than Prof. R. W. Chittenden, of Yale.

The whole drift of scientific research shows that we eat too much of the proteids, and that the nitrogen balance may be maintained with even an actual gain in strength and physical vigor by reducing the usual standard one-half or even one-third. This brings about no deterioration in the blood, and diminishes the work required of the liver and kidneys in dealing with waste and toxic products which come from excessive and even moderate meat-eating. The high-proteid diet of the American people is held to be responsible for many breakdowns, and Prof. Chittenden, of Yale, has shown that, by cutting out meat (and to a large extent even eggs), and making the proteid only sufficient in quantity to serve for necessary repairs, the endurance may be enormously increased. There is an account in the *Yale Medical Journal*, of the Yale University, for March, 1907, of a test made by Prof. Irving Fisher, of Yale, between a number of flesh-eating athletes and a number of flesh-abstainers, and the result was startling.

In the absence of any exact mechanical method of measuring endurance, three simple endurance tests were employed: First, holding the arms horizontally as long as possible; second, deep knee-bending; and third, leg-raising with the subject lying on his back. The tests were made between a number of Yale athletes accustomed to a full meat dietary, some flesh-abstaining athletes none of whom had tasted meat for some years, and also, as a

matter of interest, some flesh-abstainers who had been leading a sedentary life and had been given no previous notice of a test. The test was witnessed by a regular and somewhat distinguished committee.

The following is a summary of the test:

	Arm-holding.		Deep Knee-bending.		Leg-raising.	
	No. of persons.	Average record.	No. of persons.	Average record.	No. of persons.	Average record.
Flesh-eaters, athletes.....	15	10 min.	9	383 times	6	279 times
Flesh-abstainers, athletes..	19	39 "	16	927 "	6	288 "
Flesh-abstainers, sedentary	13	64 "	5	535 "	1	74 "

In the arm-holding test none of the flesh-eaters reached half an hour, but of the abstainers 15 exceeded it, 9 exceeded 1 hour, 4 exceeded 2 hours, one 3 hours. The flesh-eater who beat the other flesh-eaters and almost reached one-half hour, was a base-ball pitcher in active training.

In deep knee-bending only one of the nine flesh-eaters reached 1000, as against six of the abstainers, and, of these, two exceeded 2000, and one 5000. Prof. Stagg, of the University of Chicago, was one of the witnesses. The leg-raising contest was practically a tie.

This test may prove very much or very little, but it has been the basis on which a great many athletes and athletic trainers have discarded meat from the training-tables, and it foreshadows the low protein diet in every-day life for every one who wants to keep in good physical condition. There is nothing new about it. Native long-distance runners in all primitive countries of the world, and the hardy Japanese and Chinese, are practically non-flesh-eaters, and the diet of the peasantry of Ireland, of bread, potatoes, and buttermilk, has made their men strong and their women beautiful.

The indictment against meat is about as follows: It is not necessary. It is very expensive. It is a stimulant. There is enough of proteids in other foods to make meat unnecessary for tissue building. It causes gout, hardening or thickening of the arteries, premature old age, rheumatism, and many dietary ills. Not only is the uric acid in meats harmful, but poisons are generated within the body by the decomposing of the meat. The undigested meat in the colon putrifies and produces poisons which are absorbed in the body, and the effect is very much the same on endurance as the

poison from alcohol, tobacco, coffee, etc., which are forbidden in hard training. Whether all this is true or not, it is merely presented here as a live question, which, applied practically to life in the navy, indicates that the navy ration issued to the crew will probably some day come in for a balancing; and also that the chances are, in active training for athletics, a low meat diet is a safe proposition.

It is, however, as hard to imagine a social dinner without meats as it is without wines, but a liberal cutting off of alcohol, meats, coffee, and tobacco, is at least probably a good thing occasionally for any one who wishes to approximate training. The absence of meat in the diet certainly does not produce deterioration physically, provided vegetables, cereals, fruits, nuts, and breads are eaten. Certainly no one who is enjoying the stimulating effect of exercise and training needs any further stimulation, and one of the worst features of training is that, in giving it up, there usually comes a craving for stimulation.

Elimination.

As previously stated, exercise, diet, and elimination are the important factors in physical well-being. We have seen, for one thing, that deep breathing and light exercise are adjuncts of health, through aiding the process of elimination. Having finished the amateur discussion of diet, and gotten as far as eating the food, it will be found of great importance, in training, to get rid of the waste and by-products with alacrity and dispatch.

Some of the things we put in our stomachs ultimately pass off through the lungs, as in the smoke-stack of a boiler. Deep breathing is therefore worth considering. There are, however, fads in breathing, as in many other things. One instructor will tell you to breathe abdominally, and that it is the only way one should breathe. This is probably true, but women cannot breathe that way with corsets on, and as they do breathe somehow, we must consider upper chest breathing as also important, especially as it is this form of chest expansion which is measured in all physical examinations. One can certainly breathe well without moving the abdominal muscles, but a faddist has appeared recently who advocates breathing through the nose as if trying with all one's power to inhale the odor of, say a rose. As previously described, the Japanese *samurai* formerly practiced side breathing, and were able to

inflate their sides above the hips like a balloon. Any one who tries all the different methods of breathing will find that, in his sleep, he still continues to breathe naturally, and the real fact about it is that all methods are better than any one method, the main thing being to hold the chest high and breathe through the nose and as deeply as possible. Good all-around ability to breathe is a part of good all-around training. Deep breathing aids digestion, encourages liver and bowel action, develops the lungs and purifies the blood. Swimming, hill climbing, and rapid walking or running tell us where we stand in respect to breathing capacity and endurance. When one is very nearly physically exhausted by violent exertion, a quick recovery is easier by deep breathing. Throwing the arms up over the head and backwards, rhythmically, assists very much in the quick recovery of normal breathing.

Connected with the subject of deep breathing is the question of chest circumference. The following table is taken from the navy circular for enlisting:

TABLE OF PHYSICAL PROPORTIONS FOR HEIGHT, WEIGHT, AND CHEST MEASUREMENT OF ADULTS.

Height. Inches.	Weight. Pounds.	Chest, mean circumference. Inches.
64	128	33
65	130	33
66	132	33½
67	134	34
68	141	34½
69	148	34¾
70	155	35¼
71	162	36
72	169	36¼
73	176	36¾

By proper exercise and deep breathing, the circumference of the chest, even in the case of an adult person over 40 years of age, may be increased several inches. In fact, the age between 40 and 50 is the period during which the need of exercise becomes insistent because the circulation then becomes defective.

Another great agent in elimination is the skin. Unfortunately the wearing of clothes makes the problem less simple than with a horse, which animal and its training has, in the past, absorbed about as much capital and experience as an empirical science could devise. Many of us can recall that a distinguished officer of the

navy, now retired, a chief of a bureau and a man of the world, created some diversion by advocating the complete changing of underclothing with the bath or rub before dinner, as a restful, refreshing measure after the day's work, claiming that, while it need not increase the laundry bills unduly, it was exhilarating, and acted as a tonic, relieving fatigue as thoroughly as rest would do. The whole claim is perfectly true, but it has never proven as popular as the nerve-fooling cocktail before dinner. The fact remains that bathing and frequent changing of clothing next to the skin are proven factors in good health and that rubbing with a flesh-brush keeps the skin in active condition and permits it to perform its proper functions. As a matter of fact, a race horse gets more attention in these respects than we are willing to give ourselves. The efficacy of a flesh-brush on a man is shown by the cloud of dust which comes from one after each daily rubbing. Some claim that the dust comes largely from the soap used in bathing, but this may be easily shown not to be the case, and, if it were, it would be a good thing to do.

In regard to bathing, the Japanese use warm baths for opening the pores and cleansing the skin, and the cold bath for general vitalizing effect. The general hydropathic treatment in the United States is to take a warm cleansing bath once or twice a week before retiring and a short cold bath every morning on rising. A very short hot bath may be substituted for the cold bath. If any one does not get a reaction from a cold bath, the best thing is to take a warm bath and then a cold one.

The elimination of most poisons is accomplished through the liver and kidneys. With a simple diet the work of the liver and kidneys is light, but with the using of alcohol, tobacco, coffee, or any strong stimulant, the hurry call is sent in to the elimination department, and all hands are called to expel the invader. The gradual accustoming of the system to any stimulant or drug is merely an accustoming to chronic poisoning. The real way to look at drinking, or anything of that sort, is that it is playing a mean trick on one's elimination department. A person who is indifferent to a good claret, or a fine white wine, or who dislikes the flavor of a good cigar, may attain a condition of training more easily than one who feels deeply the parting with some one of the keen joys of living, but it is certainly impossible for any one to get right down to training without the cultivation of the simple life.

When all is said and done with regard to exercise and diet, there is nothing, absolutely nothing, which has a more direct bearing on health, on feeling fit, on ability to undertake hard physical or mental work, and on being in training generally, than keeping the bowels open even to the extent of two movements a day. No one can exert his full powers whose system is engaged in a struggle with poisons which are absorbed through constipation, and as between this evil and the evil of relying on aperients and drugs, the latter is preferable, but not at all necessary. The thorough mastication of food, a plain diet, water-drinking between meals, and, above all, regularity of habits, will effect cures in the most stubborn cases. In training this is most important. This is the elimination which counts, and which takes the recruit in the navy months to learn.

As a digression, and merely to satisfy a certain curiosity as to the system of mastication advocated by Mr. Horace Fletcher, it may be interesting to quote briefly from his argument, advocating the chewing of every morsel of food until reduced to a liquid in the mouth: "The field of voluntary digestion occupies only three inches of the ailmentary canal—namely, in the mouth; the field of involuntary digestion is all the rest of the ailmentary canal, approximately thirty feet. The only personal responsibility that we have is in the field of voluntary digestion. Nature has given us three inches and has herself taken on thirty feet of the problem." He claims that proper mastication insures the insalivation of the food and the proper chemical change; that it prevents lumps of food going into the stomach which cannot be reached by the digestive juices; and that it allows the appetite to discriminate so that there will not be taken into the body more than the body needs at the time. He claims also that a man fed on approximately half the food customarily taken, provided he is fed in accordance with natural demands, is assured not only complete nourishment, but immunity from the common diseases and an increase of fully fifty per cent in muscular endurance and general efficiency.

In the question under consideration, viz., elimination, the one thing on board ship which is not so available is fresh water for frequent bathing, but salt-water bathing, and at other times rubbing with a flesh-brush, or with a towel, or with the hand, will keep the skin in good condition.

Incidental to the question of diet, mastication, and elimination,

it may be noted that the best food, carefully and scientifically selected, may be spoiled in the cooking. The naval commissary school at the Training Station at Newport, R. I., which has been started within the past year, marks an epoch in the navy in this respect. The officers on board ship can regulate their diet and the cooking of their food, but the enlisted personnel can not. The establishment of this school and its branch at San Francisco for the training of commissary stewards, cooks, and bakers, is an important event.

Athletics on Board Ship.

The question of physical training in general has been considered, and it remains to apply it to conditions on board ship. There is really nothing in such conditions to make it any more difficult on board ship than on shore. On the other hand the advantage is rather the other way. The athletics here meant is, of course, not hammer throwing, sprinting, or track meets, nor that which develops stars of the field and track who are usually too strong to do ordinary work and who are apt to look for special favors through athletic superiority. What athletics we now indulge in in the navy is entirely satisfactory, but it has no direct relation to what is here advocated, which is training for the rank and file, for the under dog—for the man who needs it—not the few moments spent in setting-up drill, but the exercise which develops the man and brings him up to the average.

Can we get this on board ship practically, sensibly, really, and without humbug? Yes. Will it take an act of Congress? No. Will it require the employment of a staff of trained gymnastic instructors? No. Will it require money? Yes, about $500 per ship. Who will run it? Either the divisional officer or some officer who is interested. Should it be compulsory? No, not at first; not until it becomes generally understood.

The great trouble with indiscriminate compulsory physical drill is that a man who has been working hard has usually to go through the same work as one who wields a pen. The basis of the proposition here made is that the testing machine should be used as a guide to exercise, and that not only it, but the necessary mechanical appliances, should be furnished by the government, the work, however, to be voluntary. Meanwhile a system of general calisthenics should be made compulsory, as a drill, to take

the place of the present setting-up drill, and this calisthenics should be based somewhat on the Japanese system of training. Given an official system of general calisthenic exercise, and provided the means of voluntary development, the ultimate result should be a system of compulsory physical training. It will take time for a sufficient number of officers and men to become familiar with the testing machine, and with the mechanical apparatus to carry out the prescriptions taken from the physical charts. This it not a difficult process, but it requires instruction. Meanwhile a board of officers might be appointed to work out a system of calisthenics to take the place of the setting-up exercise.

There is nothing necessarily very difficult about devising a system. The method used in testing a person on the dynamometer brings into play, one after another, the important muscles, or groups of muscles, in the entire body. The physical chart enumerates these groups. A system of calisthenics which will exercise all these muscles, or groups of muscles, one after the other, very much like the present setting-up drill, would answer, using the resistant exercises occasionally, and varying it with the dual exercise of the *jiu jitsu*. Meanwhile, as previously stated, the testing machine and mechanical appliances should be used voluntarily. The apprentice seamen now in training at the various stations should have the system applied at once. After a few years, when the midshipmen now at the Naval Academy get out into general service, and after the system of physical development by means of tests gets better understood, the compulsory exercise on the part of the physically undeveloped will actually follow. It will take time to get it working, but it is a good investment, and is very interesting.

The following is a rough estimate of an outfit for a battleship:

One Universal Dynamometer (testing machine), complete	$150.00
Six chest weights	96.00
One shoulder lift	40.00
One head lift	40.00
One wrestling machine	40.00
Chest-weight attachments	70.00
Whiteley exercisers	40.00
One hundred wrist exercisers, at 20 cents	20.00
Total	$496.00

This does not include dumb-bells, Indian clubs, or the usual outfit of a gymnasium, because the system here advocated is more for local exercise, or for specific exercise, so to speak, than for general.

It has not been the intention to glide over details, but it is manifestly not possible within the limits of a paper of this character to write a treatise on the subject of training. *Nothing is really here advocated but intelligent physical training without fads.* There is no use in argument. If any one will try the system, he will subscribe to it. Opposition to the system can come only from misunderstanding it. Whether or not it can be applied practically on board ship is merely a question of desire. Officers who are awfully keen on additional weights on board ship will say that we have too much apparatus on board now. It is a curious fact, however, that there are lots of officers in the navy who are worrying about weights, and whether or not the armor belt is on straight, to whom a physical test will act in turning their thoughts towards the improvement in the personnel, which is, after all, the thing that counts in all navies. Our ships are all right; our gunnery is arriving, because we have the correct system; and as good as the physique of our officers and men is in general, it is idle to say that it is not a very much neglected item in the sum total that counts for war—and hence for peace.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

NAVAL STRATEGY.

By REAR-ADMIRAL STEPHEN B. LUCE, U. S. Navy.

War is *not* a game of chance, as so often asserted. The saying is true only when the game is undertaken by those unprepared for it by previous study. There are games in which there is a large element of chance; but we see proofs every day of that element being discounted, or neutralized, by the superior skill of one or the other of the players. Ordinary participants in the game, guided by a few fixed rules, are often surprised to find that, although favored by fortune at the outset, they yet lose the game. The skill of their opponent had offset the advantages which in the beginning had been all their own. The truth is forced upon them that a superficial knowledge of a few elementary rules of the art is no match for an opponent's familiarity with the principles on which the rules are founded, and an automatic readiness to apply them.

The same may be predicated of the great game of war. A knowledge of the principles of the science, combined with skill in the application of the rules deduced from them, will reduce to a minimum the chances of defeat, and enable an adept in the art to convert the errors of a more powerful adversary into a means of success.

War in its more extended sense may be regarded as a science. The growth of a science is simple. The science of law, for example, founded upon human rights and the principles of truth, equity and justice, could not have been built up save by the enunciation of those principles by eminent jurists. The precedents established by the recorded opinions of great lawyers, and the rulings of the bench, have been handed down through long lines of judges, carrying with them all the weight and force of law; indeed the findings of the courts have not infrequently been formulated into statute law. The principles of the science would lie dormant did not man breathe into them the breath of life by giving

expression to them in due form. Thus has it been with the science of war. Its principles have found expression in the deeds and maxims of eminent seamen and soldiers. Great captains, gifted by nature with a genius for war, have illustrated its principles in their campaigns and have put them down in writing, or have had them recorded by competent writers. We owe the graphic account of the "Retreat of the Ten Thousand," so famous in military annals, to Xenophon himself, and Thucydides, an admiral of the Athenian Navy, was the best naval historian of antiquity. His works should be read by every naval student to-day. In reading Arrian, observes Sir Edward Creasy, we read General Aristobulus and General Ptolemy—two of the generals of Alexander the Great—on the campaigns of the Macedonians, and it is like reading General Jomini or General Foy on the campaigns of the French. Achilles, who according to an ancient belief was of divine origin, his mother being Thetis, a sea-nymph, served as the model warrior on whom Alexander aspired to form himself. This belief no doubt suggested to Napoleon the idea that war should be represented by the head of Achilles, to indicate its divine origin. Hannibal and Scipio studied the character and achievement of Alexander and emulated his example; while Cæsar studied all three and wrote his own incomparable works, which form the basis of the science of war. Each successive school of war was founded upon the campaigns of the successful leaders who had gone before, till Napoleon came to reconstruct the art and adapt it to modern conditions. He, too, studied the campaigns of the great captains who had preceded him, and bore witness to the truth that the principles of the science never change: that what was true in the time of Alexander and of Hannibal and of Cæsar was true in his own day.

Thus step by step has the science of war been built up. The principles form the basis of the rules; and, other things being equal, he is most successful in war who has the greatest aptitude for applying those principles and putting those rules in practice. When it is found, observes one writer, that a general always attacks the key of an enemy's position with superior forces, well supported; or, in receiving an attack, opposes the enemy with greater numbers or with men securely intrenched, we need only enough instances to know that he is superior to chance. He may, in one or two cases, be called lucky; but when he is found always

to do the same thing, and is always on the right spot, at the right time, with his men rested and his trenches dry, we then understand that he knows his business—that he is a past master in the art of war. Thus has it been going on for ages. The maxims of Napoleon alone form a compendium of the art of war, and their interest to the naval student is that they apply in many cases to the operations of a fleet just as well as they do to the operations of an army.

It is well understood that rules cannot be given to suit in every instance, and when they do cover a given case, blind adherence to them does not always ensure victory. During the War of the Spanish Succession, Lord Galway, an experienced soldier, thought it more honorable to fail according to rule than to succeed by innovation. This great commander, we are told, conducted the campaign of 1707 in the most scientific manner. On the plains of Almanza he encountered the army of the Bourbons. He drew up his troops according to the methods prescribed by the best writers and in a few hours lost eighteen thousand men, one hundred and twenty standards, all his baggage and all his artillery.

NOTE.—The War of the Spanish Succession gave to England Gibraltar and Minorca, separating the southern parts of France from the western, neutralizing Toulon, which Louis XIV had designed as a great naval depot. Gibraltar and Port Mahon in the hands of England enabled her to control the trade of the Levant. The war was terminated by the treaty of Utrecht in 1713.

A knowledge of military and naval history shows us what errors in war have been committed, and instructs us how they may be avoided. A knowledge of principles enables us to form our own rules to meet special needs, and a knowledge of the rules will often enable one to avoid committing blunders which have become historic. The most that can be claimed for a knowledge of the science of war is that it so prepares the student that he may *make the least number of mistakes.*

The greatest captains known to history have made mistakes in war. Cæsar, it is said, accomplished his self-training in war by dint of many errors. His knowledge of the art was acquired by the mistakes he had made and intelligently profited by. Turenne, on being asked how he had lost the battle of Muriendahl, replied, "by my own fault; but," he added, "when a man has committed no faults in war he can only have been engaged in it but a short

time." The great Frederick candidly acknowledged that no general had ever committed greater faults than he had. But to the reverses of the campaign of 1744 he always ascribed his subsequent successes. It was in the midst of difficulty and disgrace that he caught the first clear glimpse of the principles of military science. Napoleon, himself, confessed that he had been so often mistaken that he no longer blushed for it. "Don't be discouraged! It was my fault this time!" cried out General Lee to the retreating Confederates on the third day's fighting at Gettysburg; a frank admission that disarms all criticism.

Military and naval histories, observes one authority, while warning the student against such mistakes, are yet the depositories of maxims which genius has suggested and experience confirmed. They both lighten the way and shorten the road of the traveler and render the labor and genius of past ages tributary to our own. These teach us most emphatically that the secret of successful war is not to be found in mere legs and arms, *but in the head that shall direct them.* If this be either ungifted by nature or uninstructed by study and reflection, the best plans of campaigns are of no avail. This is true of naval operations. Ships and guns may be all that the most advanced science and the highest state of art can produce; but if the genius to combine the various units to the greatest advantage, to direct their movements with skill, and supply their needs, be wanting, they can contribute but little to success in war.

What the great soldiers of past ages have done for the military art, the great seamen have in a measure failed to do for the naval art. The latter were not men of letters. The orders of battle of many of the celebrated admirals known to history, the maxims by which they have been guided, the opinions on naval operations they have given utterance to have seldom been recorded, or when they have been, the records are not always easy of access. Up to a very recent date no one had appeared to gather together the mass of valuable material that lay scattered about in all but forgotten volumes, classify and arrange in order all that was of value, and sift out and reject the volume of fable interwoven with serious history and from the residuum deduce the science of naval warfare.

The naval student has not as a rule appreciated the full value of military history as a guide and helper in his studies. And yet

the constant recurrence of the application of certain rules of the art of war observable in military movements on land suggests the continuity of similar rules in military movements at sea.

"I am struck," writes General Lord Wolseley, in his articles on our Civil War, "I am struck throughout the whole story of the minor operations of this period by the illustrations they afford of the regularity with which the old rules and principles of war assert their supremacy." He then instances two battles (Wilson's Creek, May 10, 1861, and Pea Ridge, March 7, 1862) "curiously alike in the military lessons they furnish." "Both failed," he adds, "as might have been predicted." That is to say, failed through ignorance of first principles.

Colonel Henderson, R. A., observes that, of the mighty host put in the field of the Civil War, by the North, and the thoroughness of its organization as a fighting machine, one factor was overlooked—*intelligent control*. This was during the earlier days of the war. "Men who, aware of their own ignorance, would probably have shrunk from assuming charge of a squad of infantry in action, had no hesitation in attempting to direct a mighty army, a task which Napoleon has assured us requires profound study, incessant application, and wide experience." Strategy is an art in itself, to attain success in which one must serve a long apprenticeship. The rules of strategy are few and simple and may be mastered in a week. But such knowledge will no more enable a man to lead an army as Napoleon did, or conduct a naval campaign as Nelson did, than a knowledge of English grammar will teach a man to write as Gibbon did. A truly pathetic picture is drawn of the great and good Lincoln poring night after night, while all Washington was asleep, over the pages of Jomini and Clausewitz, trying to master the art of war and only too glad to shift the load onto Grant. "I do not ask for your plans," he said; "go ahead, and when you need assistance call on me." He had learned that a man cannot become a strategist by cramming!

"It is a significant fact that during the three years the control of the armies of the North remained in the hands of the Cabinet the balance of success lay with the Confederates. But when Mr. Lincoln abdicated his military functions in favor of Grant, the Secretary of War had nothing more to do than comply with his (Grant's) requisitions." (Lieut.-Col. Henderson, English Staff College.) This practice—the Cabinet directing the operations of

war—was repeated at the outset of the Spanish War, and with equal want of success. We failed to profit by our own experience in war and are still in the same condemnation.

General Sherman, in a very interesting and instructive article (Century Magazine, February, 1888), points out that in our Civil War it was the "educated soldiers" who made the fewest mistakes; and that, when mistakes were made, the movement was *in violation of the "lessons taught by the great masters of the art."* Hence the necessity of studying the great masters, a necessity imposed upon the seaman as well as upon the soldier.

"Out of the experience of great soldiers," says General Sherman, himself a great soldier, "arose certain rules which made the art of war. These rules are as true as the multiplication table or the law of gravitation; their operation is as certain as that of any of the physical laws. The art of war has grown into a science demanding as much, if not more, study than most of the sciences in which the human mind is interested." "Grant's attack on Grand Gulf, and subsequent landing at Bruinsburg; the movement on and battle at Port Gibson; the rapid march to Jackson, whereby he drove Pemberton to his trenches and then invested him till his surrender, July 4, 1863, all these operations illustrated the highest principles of war, one of its maxims being to divide your enemy and beat each moiety in detail." The same principles precisely apply to naval operations. It was through ignoring this sound maxim that the English Admiral Graves, in 1781, permitted the junction off the Cape of Virginia, of the French fleets under de Grasse and de Barras, respectively, and missed his great objective, the beleaguered army of Cornwallis at Yorktown; and during the Trafalgar campaign the English Admiral Cornwallis made a similar mistake.

Another well established rule applicable alike to an army operating on land and an army operating on the high seas is that an army having assumed the offensive must maintain the offensive. This General Sherman illustrates by the series of movements of the Union Army under Grant in 1862 and 1863, having Chattanooga for its objective. "All these movements were made strictly according to the lessons of war as taught by the great masters."

The object of General Sherman's admirable article is to show that the Civil War brought forth, on both sides, the knowledge, talents, and qualities necessary to the occasion; that success resulted from the same qualities, the same knowledge of, and adher-

ence to, the rules of war, which have achieved success in other ages and in other lands, and that military knowledge acquired beforehand was most valuable, though not always conclusive. The same knowledge might have been and was acquired in actual war, though often at a terrible expense of human life and misery.

General Sherman's conclusion is that "there may be such men as born generals; but I have never encountered them, and doubt the wisdom of trusting to their turning up in an emergency." The whole tenor of this instructive article is to emphasize the value in war of the educated seaman and soldier and is the strongest possible appeal for the higher education of officers of the military and naval services. "Of all the professions of life," observes Prof. John Fiske, in writing of our Civil War, "there is none in which the imperative need of professional training is so forcibly demonstrated as in warfare, where errors of judgment are visited with such prompt and terrible penalties." Says that profound thinker, the "father of modern political economy," "the art of war is the noblest of all arts and has become the most complicated. In order to carry it to any degree of perfection it is necessary that it should become the sole or principal occupation of a particular class of citizens." (Adam Smith, Vol. 4, p. 53.)

Naval Strategy.—If we now consider the subject of naval strategy, it will be found that in this branch of the art of war the analogy between military operations and naval operations loses itself in identity. In the definitions of strategy given by military writers one has only to substitute the word fleet for army. The field of battle, observes Hamley, is the province of tactics. The whole theatre of war is the province of strategy. It is the object of strategy so to direct the movements of a fleet that when the decisive collision occurs, it shall encounter the enemy with increased relative advantage. When the movements of one of two fleets have been so directed as to increase the chances in its favor, by forcing the enemy either to engage at a disadvantage, or to abandon a strategic point, or position of advantage, under penalty of worse disaster, there is proof of a power (brain power) which differs from the mere ability to fight. The Trafalgar campaign, which deserves careful study, furnishes illustrations of the soundness of these views.

Of two fleets, each having equal chances of victory, the defeat of one may be simply a reverse, with a large residuum of recu-

perative power; while, to the other, defeat would be absolute ruin. The defeat of the American squadron at Manila, May 1, 1898, would have been a disaster, the effect of which it would be difficult to compute. Failure to gain a decisive victory, even, would have been almost as fatal as actual defeat, for Admiral Dewey had no base to fall back upon, no *point d'appui*. The risks taken were enormous, but fully justified by the event.

The triumph of strategy is complete when the commander of one of two originally equal forces succeeds by the combinations of the campaign in bringing his adversary's fleet into a position where the chances of victory are greatly against it, and where defeat will entail disasters beyond the mere loss of the battle. Had the Spanish squadron under Cervera, on first reaching the West Indies, fallen in with a small portion of the American forces in those waters, the defeat of the latter would have been of comparatively minor importance, whereas the defeat of the Spaniards would have resulted, as it actually did, in ruin so complete and results so far-reaching as to practically end the war.

It may, and sometimes does, happen that the results of a campaign depend more upon strategy than upon tactics, more upon movements than upon victories gained in battle. From the French army of the Danube the left wing of General Kray marched rapidly through Switzerland to the right extremity of the Austrian line and by that movement alone conquered all the country between the Rhine and the Danube without pulling a trigger. In 1805 the army of Mack was completely paralysed and the main body forced to surrender at Ulm without a single important battle. In 1898 Spain ordered Admiral Camara with a squadron to proceed to the Philippines to retrieve the loss of Montojo's command and regain Manila. He got as far as the Suez Canal, when the squadron under Rear-Admiral Watson threatened, through the press of the country, the coasts of Spain. The news of this projected movement caused the immediate recall of Camara. (It was a well-known practice of Napoleon to contrive to have his emissaries carrying important dispatches, captured by the enemy. These dispatches were so artfully worded as to completely deceive the enemy. This led to the suggestion that there should be in our Navy Department a Bureau of Misinformation.)

It is one of the oft-quoted sayings of Napoleon that to acquire the secret of the art of war one must read, again and again, the

campaigns of the great captains. "Model yourself upon them," he said. But of strategy he has assured us that there is only one means of mastering it, and that is by incessant study and exhaustive thought. And Nelson's legacy to us, observes a recent English writer, is that "strategy and tactical study is that which above all things a naval officer should occupy himself with."

Of all the great games of war of modern times, the one possessed of most interest to the naval student is that in which the British Admiralty was pitted against one of the greatest masters of the art of war of all times—Napoleon. The stake played for was nothing less than an empire. Great Britain, including her entire colonial system, was the prize. It was a struggle against sea-power by the first captain of the age, and sea-power prevailed. The theatre of the war embraced practically the four quarters of the globe.

The story of Trafalgar has been so admirably well told in a course of lectures deliverel at the Naval War College, and now to be found, under the title of Sea Power, in every library, as to leave little to be said save in the way of drawing from it lessons for our instruction.

"Let us be masters of the English Channel for six hours," said Napoleon, "and we shall be masters of the world!" That was the war problem he undertook to solve. But the British Admiralty understood the game better than its opponent, and Napoleon lost. The first object of Napoleon was to lure away the English fleet in order to get control of the Channel. With that view the French fleet, under Villeneuve, was sent to the West Indies to threaten the English possessions in that quarter. Nelson followed in pursuit. On June 4, 1805, the hostile fleets were about 100 miles apart, Nelson with 12 ships of the line at Barbadoes, Villeneuve at Martinique with 20.

June 12, Nelson, then off Antigua, feeling convinced that the French fleet had sailed for Europe, hurried off the brig *Curieux*, Captain Bettesworth, with dispatches to the Admiralty conveying the intelligence that Villeneuve had left the West Indies but that his destination could only be surmised. Captain Bettesworth was to deliver the dispatches in person. Carrying a heavy press of sail, the *Curieux* reached Plymouth July 7. Captain Bettesworth posted to London, where he arrived at 11 o'clock on the night of the 8th. The First Lord of the Admiralty, Admiral Lord Barham,

having gone to bed, Nelson's dispatches were not given him till early next morning. He exclaimed angrily, on receiving them, of the loss of so many precious hours. Without waiting to dress, he at once dictated orders, with which, by 9 a. m. of the 9th, Admiralty messengers were hurrying to Plymouth and to Portsmouth.

Cornwallis was directed to raise the blockade at Rochefort, sending 5 ships to Sir Robert Calder, who was then watching off Ferrol with 10. The latter was ordered, with the 15 ships thus united under his command, to cruise 100 miles west of Cape Finisterre to intercept Villeneuve and prevent his junction with the Ferrol squadron. Cornwallis received his orders on the 11th, and on the 15th, eight days after the *Curieux* anchored in Plymouth Sound, the Rochefort ships joined Calder. The latter at once proceeded to the post assigned him. On the 22d the sudden lifting of a dense fog revealed to each other the hostile forces of Calder and Villeneuve, the British 15 sail of the line, the Allies 20. This was one of the most dramatic scenes of the whole campaign. Was it mere chance that brought these two opposing forces to confront each other at that particular time and place? Was it not rather a fine exhibition of skill of two accomplished strategists?

"It is difficult," observes the author (Mahan), "to praise too highly the prompt and decisive step taken by Admiral Lord Barham when so suddenly confronted with the dilemma of either raising the blockade off Rochefort and Ferrol or permitting Villeneuve to proceed unmolested to his destination, whatever that might be. To act instantly and rightly in so distressing a perplexity, to be able unhesitatingly to make a sacrifice of advantages long and justly cherished, in order to strike at once one of the two converging detachments of an enemy, shows generalship of a high order."

Napoleon, himself, was entirely misled by Lord Barham's prompt measures, whose rapidity even he could not have surpassed. "The *Curieux*," he said, "only reached England on the 9th, and the Admiralty could not decide on the movement of its squadrons in 24 hours."

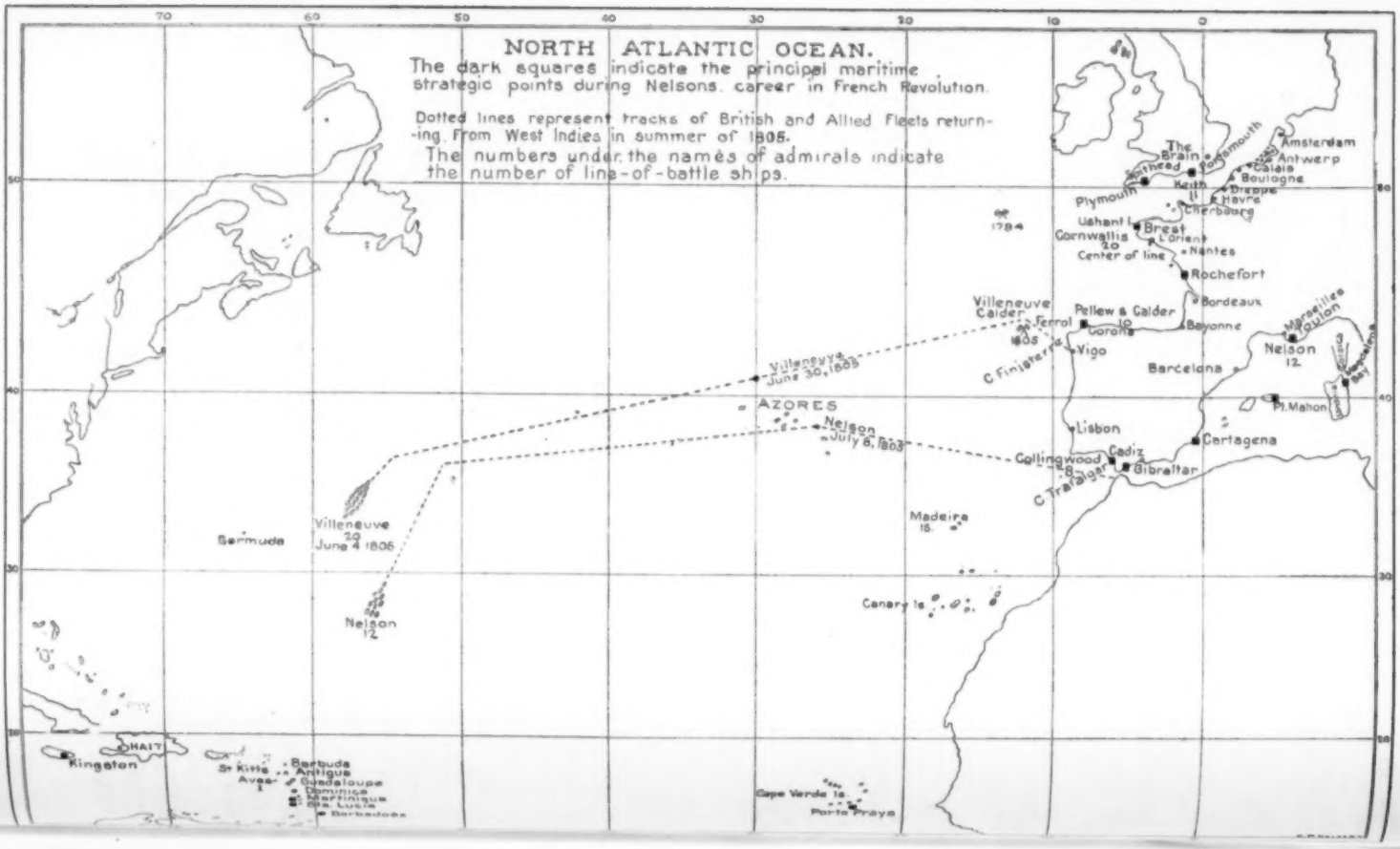
Charles Middleton, Admiral Lord Barham, was at this time 80 years old, too old, some English writers maintain, to be at the head of the Admiralty during a time of war or even in peace. He had been but two months in office. His prompt action on the morning of the 7th, they say, was simply the carrying out of plans already

matured by the Board of Admiralty. However that may be, the plans were well conceived by somebody in the Admiralty, be the credit for them whose it may, and the strategic combinations were identical with those laid down by the best military authorities.

The rest of the story, omitting details, is soon told. Sir Robert Calder was unequal to the task imposed upon him. After an indecisive action the two fleets separated. Villeneuve was enabled to reach Vigo on the 28th of July; few days later, favored by the wind, he reached Coruña (August 1) and effected the junction with the allied forces in the harbor of Ferrol, which it had been the very object of the English Admiralty to prevent. On learning (August 13) that Villeneuve had reached Coruña, Napoleon wrote to his Minister of Marine, "If with thirty ships my admirals fear twenty-four British, we may as well give up all hope of a navy." No more forcible illustration could be given to show that *numbers* do not mean efficiency. It is not an uncommon cry with us to-day: "Give us more ships, for we *must* have an efficient navy." *Numbers do not constitute efficiency.* The fighting qualities of the Spaniards none can dispute. And yet Napoleon reckoned one French ship of the line as equal to two of the Spanish; it was simply a question of the relative efficiency of the two navies.

Calder now joined Cornwallis (Admiral Sir William Cornwallis, brother of Lord Cornwallis who surrendered at Yorktown in 1781) off Brest, raising, with some of Nelson's ships, that force to 34 ships of the line, all admirably disciplined. The Allies had in Brest 21 ships, in Ferrol 29, neither of which was equal in number, still less in quality, to those under Cornwallis. The naval situation, continues the author, was now comparatively simple. Cornwallis was superior to either of the enemy's detachments, and he held the interior position. In case Villeneuve approached, it was scarcely possible that the two hostile fleets, dependent upon the wind, which, if fair for one, would be foul for the other, could unite before he could crush one of them. It was equally improbable that, with all their lookout frigates, or, as we now call them, scouts, Villeneuve could elude the British fleet and gain so far the start of it as to cover the straits of Dover during the time required by Napoleon.

"In his concentrated force, therefore," continues the author, "and his interior position, Cornwallis controlled the issue." But


NORTH ATLANTIC OCEAN.
The dark squares indicate the principal maritime strategic points during Nelsons career in French Revolution.
Dotted lines represent tracks of British and Allied Fleets returning From West Indies in summer of 1805.
The numbers under the names of admirals indicate the number of line-of-battle ships.
70
60
50
40
30
20
10
0
50
40
30
20
The Brain
Portsmouth
Amsterdam
Antwerp
Calais
Boulogne
Spithead
Keith 11
Dieppe
Le Havre
Plymouth
Cherbourg
Ushant
Brest
L'Orient
Cornwallis 20
Center of line
Nantes
Rochefort
1784
Villeneuve
Calder
Bordeaux
Pellew & Calder 10
Bayonne
Ferrol
Corunna
Marseilles
Toulon
1805
Vigo
C Finisterre
Nelson 12
Barcelona
Genoa
Villeneuve June 30, 1805
AZORES
Nelson July 6, 1805
Lisbon
Pt. Mahon
Cartagena
Collingwood 8
Cadiz
Gibraltar
C Trafalgar
Madeira 15
Villeneuve 20 June 4 1806
Bermuda
Canary Is
Nelson 12
HAITI
Ringston
St Kitts
Barbuda
Antigua
Avas
Guadeloupe
Dominica
Martinique
St. Lucia
Barbadoes
Cape Verde Is
Porto Praya

to borrow General Sherman's form of expression, he acted "in violation of the lessons of war as taught by the great masters." He threw away his great advantage. On learning that Villeneuve had put to sea with 27 or 28 ships of the line, he at once dispatched Sir Robert Calder towards Ferrol with 18 sail, keeping 16 for himself. This separation of the two parts of his fleet, says the author, is condemned by the simplest and most generally accepted principles of warfare. It transferred to Villeneuve all the advantage of central position and superior force and was stigmatized by Napoleon himself as a glaring blunder. So much for not knowing one's business!

"While the British squadrons were concentrating in the Bay of Biscay, and the diligence of Nelson was bringing the Mediterranean ships to the critical center of action, Napoleon, from the heights overlooking Boulogne, was eagerly awaiting news from Villeneuve, from whose skill, zeal and courage everything was to be hoped."* He leaned upon a broken reed. Villeneuve's heart failed him. Instead of making for the Straits of Dover he steered for Cadiz!—and the game was practically up.

The sudden collapse of all of Napoleon's long and carefully thought-out plans of invasion calls to mind another occasion, when a thoroughly efficient but comparatively small fleet turned back what promised to be a tidal wave of subjugation of a free people:

A king sate on the rocky brow
  Which looks o'er sea-born Salamis;
And ships, by thousands, lay below,
  And men in nations;—all were his!
He counted them at break of day—
And when the sun set, where were they?

Let us now go back and ask who it was that directed all these great movements of the English fleets? For even Nelson himself, with all his genius for war, was but a single factor in the hands of the supreme directorate of the various strategic movements. It matters not whether the master mind was Lord Barham's or that of his staff. For our purpose it was the British Admiralty. And therein lies the question for our navy to consider—the creation of a directive agency to project strategic movements covering the entire theatre of war, embracing, it may be, the four quarters of the

* Mahan.

globe. The study of naval battle tactics is eminently proper—say rather, indispensable; but it is, after all, providing for contingencies more or less remote; while the creation of an intelligent directive force that can, during peace, foresee and provide for the contingencies of war, and efficiently direct the operations of the fleet when war does come, is a practical question of the present.

To avoid the possibility of misapprehension it is proper to state, in this connection, that our form of government, and the genius of our people, demand that the Secretary of the United States Navy must, and always should be, a civilian, selected by the President with a special view to his fitness for the office. Our insistence is, that the civilian who occupies this high and responsible position shall have at his elbow, at all times, able and responsible advisers on all questions relating to war and to the preparation for war: He should be furnished, by law, with a Board of Directors, by what name soever it may be called.

Having defined strategy as it is applied to military and naval operations, and shown by ample illustrations what a prime factor it is in war, let us now proceed to inquire how the United States manages such matters. The head of our Admiralty has put it on record that for the first *seven months* of the Civil War, " but for some redeeming naval successes at Hatteras and Port Royal, S. C., ... the whole belligerent operations would have been *pronounced weak and imbecile failures.*" *Per contra,* the Prussian campaign of 1866, during which the naval battle of Lissa was fought, lasted *but seven weeks,* resulting in the consolidation of the German Empire!

In regard to one of the greatest strategic movements of the Civil War, the capture of New Orleans and the control of the Mississippi river, the head of our Admiralty wrote: " In general and desultory conversation with military and naval men and others, the passage of the forts and the capture of New Orleans was spoken of as desirable, but not a practicable undertaking." The views of the Department on the subject were " speculative and uncertain." The movement which led to the capture of New Orleans and the ultimate control of the Mississippi was the result of fortuitous circumstances, and the active part taken by parties not connected with the Navy Department. The latter heartily cooperated in the movement, it is true; it simply did not take the initiative, as it should have done, and would have done had the

Secretary of the Navy enjoyed the advantages of presiding over a Board of Directors, and listening to the counsel of expert advisers. It is submitted to an intelligent, patriotic and practical people if that is the way to carry on naval operations in war—by "desultory conversations of a civilian with military and naval men"? An endeavor has been made to show that war is, in one sense, a science, to master which requires profound study. In another sense it is an art, to become an adept in which a man must devote all the faculties with which nature has endowed him. To assign to the control of the Admiralty, with all its vast responsibilities, a civilian, however eminent, without a staff of naval experts, is only to imperil the highest interests of the country, to sacrifice precious lives, to waste munitions of war, and place the civilian head of the navy in an utterly false position. That is what was done in the Civil War and repeated up to a certain point in the Spanish War. In respect to naval affairs Americans seem incapable of profiting by their own mistakes in war.

A generation after the Civil War came the war with Spain, only to find our Admiralty as incompetent as ever. The battleship *Maine* was destroyed in the harbor of Havana, February 15, 1898. Ten days later (February 25) the Assistant Secretary of the Navy telegraphed to Commodore Dewey at Honkong:

> Secret and confidential. Order Squadron, except *Monocacy*, to Hongkong. Keep full of coal. In the event of declaration of war (with) Spain, your duty will be to see that the Spanish Squadron does not leave the Asiatic Coast, and then begin offensive operations in Philippine Islands. Keep Olympia * until further orders.
>
> (Signed) ROOSEVELT.

From the date of the Assistant Secretary's dispatch, February 25, to the actual breaking out of the war, April 21—nearly two months—much precious time was lost in preparing for hostilities. Three days later, April 24, came the dispatch from Commodore Dewey which ran as follows:

> Hongkong, April 25, 1898. Secretary of the Navy, Washington. In accordance with the request of the Governor of Hongkong the Squadron leaves to-day for Mirs Bay, China, to await telegraphic instructions. Address Hongkong. Communicate by tug.
>
> (Signed) DEWEY.

* The Olympia had been ordered home. From this time on all the dispatches sent out from the Navy Department indicate that the Government fully anticipated a war with Spain.

One would have supposed that with all our experience during the four years of the Civil War prompt measures would have been taken to meet the crisis which everybody saw was at hand; and that Commodore Dewey would not have been left so long in suspense and finally placed in the humiliating position of being requested to leave Hongkong. Such, unfortunately, was not the case.

The dispatch to Commodore Dewey from the Assistant Secretary of the Navy, who seems to have been the only one of the administration to comprehend the necessity of action, was dated February 25, 1898. The dispatch from Commodore Dewey announcing the action of the Governor of Hongkong was dated April 25, an interval of sixty days. Now it required but 54 days for the powerful monitor, *Monterey,* and the collier, *Brutus,* to go from San Francisco to Manila. Had those vessels been ordered to join Commodore Dewey at the date of the dispatch of the Assistant Secretary of the Navy, they would have reached their destination in time, if not to take part in the action of May 1, they would have at least exercised a wholesome moral effect on natives and foreigners alike, and would have relieved Commodore Dewey of all cause of anxiety. As a matter of fact the *Monterey* did not leave San Francisco till *41 days after the battle of Manila!* The excuse is that the monitor was not ready for sea. Of course she was not. How could she be ready? The Commandant of the Mare Island Navy Yard, California, where she then was, could not fit her out for sea without orders from headquarters, and there was no one at headquarters upon whom that duty devolved. The civilian Secretary of the Navy knew absolutely nothing about such things, and his advisers, the several Chiefs of Bureaus, foreseeing that war was imminent, were fully taken up with matters pertaining to their respective bureaus which had to do with other matters. The Chief of the Bureau of Navigation, who has a quasi-military character, in default of a special office for the direction of military operations, was already overloaded with the details of his own bureau. The Naval War Board did not come into existence till May 2, the day after the battle of Manila.

The dispatch from Commodore Dewey of April 25 informing the Secretary of the Navy that he had been "requested" to leave Hongkong was received at the Navy Department on Sunday morning. The Department was practically deserted. But the

Bureau of Navigation was never closed, during the war. The dispatch was received by Lieut. H. H. Whittlesey, U. S. N., then on duty in the Bureau. Lieut. Whittlesey took it at once to the house of Captain Crowninshield, the Chief of the Bureau of Navigation. Captain, the late Rear-Admiral, Crowninshield, under date of July 9, 1901, gave out the following very interesting account of the dictating by President McKinley of the now "famous dispatch" to Admiral Dewey. This account, we may premise, is now of no little historic value as an incident of our naval annals:

On Sunday, April 24, 1898, Lieutenant H. H. Whittlesey called at my home with a despatch from Admiral Dewey, stating that the Governor of Hongkong had notified him that he must leave that port with the force under his command within forty-eight hours.

Deeming it of the greatest importance that a reply should be sent as soon as possible to Admiral Dewey, I took the despatch to the White House and laid it before the President. The President directed me to go and find Mr. Long, the Secretary of the Navy, and Judge Day, the Secretary of State, and bring them to the White House. Upon returning to the White House, I was shown to the western end of the upper corridor, where the President was sitting with the following persons: Secretary Day, Attorney-General Griggs, Senator Hale and one other, possibly Secretary Bliss, though I am not sure. The late Senator Davis joined the party later.

A discussion of the despatch from Admiral Dewey and the reply which should be sent to him was taking place when I arrived, in which I took part for several minutes. The President then turned to Attorney-General Griggs and said: "Griggs, you write a despatch for Dewey to proceed to Manila and attack the Spanish naval force assembled there," whereupon Attorney-General Griggs turned to me and said: "Captain, you know how to write that better than I do; you go and write it. You will find some blanks in the Cabinet room."

I at once proceeded to the Cabinet room and wrote the despatch. Returning to the Presidential party I handed the despatch I had prepared to Attorney-General Griggs, who said it was satisfactory and handed it to the President, who read it aloud.

The only change that was made in the despatch as I wrote it was the addition of either the word "capture" or the word "destroy." The despatch as originally written by me contained but one of these words, but which one I do not recall.

I then went over to the Navy Department, handed the despatch to Lieutenant Whittlesey and directed him to go ahead and put it into cipher. Lieutenant Whittlesey reported to me the same evening that the Secretary had signed the despatch and that it had been sent.

The experiment that had failed lamentably in 1862 was tried again in 1898. During the first three years of the Civil War, as

already related, the President had exercised his military functions as constitutional commander-in-chief, with what unfortunate results we have seen. The President was now to try it again in the war with Spain with no better success. As early as March 9, Congress voted $50,000,000 for national defense; and Admiral Dewey testified before the Senate Committee, June 26, 1902, that war with Spain was regarded out there (China) as certain as early as April 1, and that if he had had timely reënforcements the insurrection which cost so many precious lives would have been averted.

It is a fatal mistake to adapt the amenities of peace to the prosecution of war. "If there be any truth established by the universal experience of nations, it is this, that to carry the spirit of peace into war is a weak and cruel policy. The time of negotiation is the time for deliberation and delay. But when an extreme case calls for that remedy which is, in its own nature, most violent and which, in such cases, is a remedy only because it is violent, it is idle to think of mitigating and diluting."

The Naval War Board came into existence not a day too soon. It stood for a Naval Staff, and was successful in pulling the Department through the war. The Secretary of the Navy of that day pays it the following well merited compliment: "The Board (Naval War Board) possessed high intelligence and excellent judgment and its service was invaluable in connection with the successful conduct of the war." And yet it was summarily dissolved at the close of the war! Its great value as a premanent office was not understood.

The Naval War Board had to do with the very questions of naval strategy, the subject of which we have been dealing. Some of the most important strategic measures are those adopted during peace—adopted perhaps many years in advance of even the prospect of hostilities. The British Admiralty has matured plans for the construction of a large dockyard, comprising about fifty-two acres, at Rosyth, on the north side of the Firth of Forth. It will become in no great while one of the most important naval stations in the kingdom. As a strategic point it will furnish a base for naval operations in the North Sea, should the tide of war ever tend in that direction.

It may readily be seen, from what has gone before, that by the timely occupation and security, during peace, of an important

strategic point, a war may be averted. It is that consideration that makes a Naval Staff an indispensable part of an enlightened system of naval administration, not less in peace than in war. Pearl Harbor, Hawaii, is another illustration of the wisdom of securing during peace an important strategic point. The value from a military point of view of a naval base in those islands can scarcely be exaggerated. The navy is indebted for this great acquisition to the happy accident of a gentleman, in no way connected with the executive branch of the government, visiting Hawaii not long since. Becoming convinced, from personal observation, of the manifold advantages of Pearl Harbor for naval and military purposes, he resolved that active measures for the establishment there of a naval base should no longer be delayed.

In 1893, while Captain A. T. Mahan, the President of the Naval War College, was still engaged in his studies and resultant lectures on naval strategy, there appeared in the *Forum* of March of that year an article from his pen entitled "Hawaii and our Future Sea Power." This article attracted just enough attention, at the time, to cause the author to be summarily detached from the War College and sent to sea, the administration of that day not being in favor of the taking over of the Hawaiian group. But the cogent arguments advanced by the eminent author, showing the great advantages, from a strategic point of view, of the possession of those islands, served to crystallize current thought of the past sixty years on the subject, and matters finally began to take definite shape. On the 6th of April last, bill H. R. 20308 to establish a naval station at Pearl Harbor, Hawaii, being under discussion in the House, there were disclosed some interesting facts in connection with our methods of conducting the affairs of the navy.* For whereas the naval station at Rosyth was established by the English Admiralty, the naval station at Pearl Harbor was established by Congress on its own initiative.

In the hearing before the Naval Committee of the House, January 29, 1908, on the subject of Pearl Harbor, one of the delegates from Hawaii (Mr. Kalanianaole) said: "The importance of Pearl Harbor as a naval and military base has been repeatedly urged by men able and experienced in military and naval science, among them Captain A. T. Mahan, who pointed out with unanswerable arguments the commanding importance of Pearl

* See Congressional Record, April 6, 1908, pages 4562-63.

Harbor as the key to the Pacific." The Hon. A. L. Bates, having in charge the bill for the "establishment of a naval base at Pearl Harbor," in his report, March 2, 1908, quotes the opinions of Captain Mahan as to its great importance from a naval and military point of view. And Senator George C. Perkins, member of the Naval Committee of the Senate, in a powerful plea for the establishment of a naval base at Hawaii, states that "in 1893 our greatest authority on sea power and naval strategy, Captain A. T. Mahan, wrote with reference to the proposed annexation of Hawaii," etc. The Senator then quotes from the *Forum* article of March, 1893, in which the strategic importance of the islands is fully set forth.

We put it fairly and squarely to the naval profession and to the public generally, if the operations of war, involving naval strategy, as we have endeavored to define and illustrate it, can be successfully conducted save by a directorate composed in part, at least, of those who have made the study of the Science and Art of War their chief occupation?

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE SIGHT BAR RANGE.

By CAPTAIN BRADLEY A. FISKE, U. S. Navy.

There are two ways of finding the sight bar range; one is by correcting a previous sight bar range by spotting from aloft, and the other is by measuring the range directly with range-finders.

If either method be used, it is first necessary to calibrate all the guns. If the spotting method be used, all guns of each caliber must be calibrated with a standard gun of that caliber; if the range-finder method be used, each gun must be calibrated with the range-finder that is to get its sight bar range.

In order to compare the accuracy of the two methods, it is necessary first to recognize the fact that, in the spotting method, there are two errors, the error of the gun and the error of the spotter, the combined error being the square root of the sum of their squares; while in the range-finder method, the only error is the error of the range-finder.

The mean errors of our guns, when fired on board ship under the conditions of calibration practice, can easily be obtained from our "calibration data." Perhaps it would not be proper to state here what these data are, but neither would it be necessary, for they are generally known in the service. Neither would it be possible to deduce mathematically from these data what would be the mean error, if these guns were fired at sea under given average conditions of weather. But surely it would be an optimistic man who, knowing the results of calibration practice, would insist that the mean error of a 12-inch gun, fired at sea, under ordinary conditions, would be less than 100 yards at 6000 yards.

The writer begs permission, therefore, to assume the mean error of a 12-inch gun, fired at sea, as at least 100 yards at 6000 yards.

In order to form an estimate as to what the spotting error would be, the writer modified the spotting board of the *Tennessee*, so

that spotting at sea would be simulated. The target, instead of being fixed in one place, was made adjustable at distances between 6000 and 7000 yards; and the sea, instead of being flat, was represented as having waves 10 feet high, from crest to hollow, and 100 yards apart. The board representing this sea could be moved along the line between the observer and the target at the proper speed; and the target, resting upon the "waves," would rise and fall in guides as the sea moved under it. A white cylinder of wood, which could be placed at any distance between 0 and 600 yards from the target, represented a splash, and it would rise and fall like a splash, when the "waves" passed under it.

This board was put on the quarter-deck and the officers were requested to practice with it. After they had more practice with it than a spotter can ever get *at sea* under given conditions, each officer spotted twenty times, being allowed five seconds in which to make his estimate, the splash being differently placed each time. Ten officers took twenty observations each, and the mean of their errors was 85 yards at about 6600 yards = 70 yards at 6000 yards.

Adding the square of this to the square of 100, and taking the square root of the sum, gives 122. So it seems reasonable to conclude that the probable error of the spotting method, used at sea, would be at least 122 yards at 6000 yards.

In order to compare the accuracy of the range-finder with this, the writer directed Midshipman Frank Russell to take charge of the two range-finders of the *Tennessee* and see what he could do with them. Mr. Russell had had about as much experience with range-finders as other midshipmen; but I told him that I was sure from my own experience that the reasons for the inaccuracy of the range-finders in our ships were simply lack of practice of the observers and the fact that the coincidence adjustment for infinity was frequently obtained by sighting on stars too high above the horizon.

To remedy the latter trouble, I adopted a modification of a plan which I used some years ago, for getting the infinity adjustment of my electrical range-finders—that of sighting on two lines as far apart as the length of the base line; and with the authority of the commander-in-chief of the Pacific fleet, I made two "correctors" of mahogany, with two parallel lines on each, 54 inches apart.

Mr. Russell became very much interested in the work and practiced with the range-finders under difficult conditions of weather and vibration. About this time, Captain Knight, of the *Washington*, gave Midshipman Bruce instructions like those I had given Mr. Russell.

On October 9, 1908, the *Tennessee* and the *Washington*, being then 2040 yards apart, steered courses diverging three points, by order of the commander of the second division, for half-an-hour, and then converged three points, taking simultaneous reciprocal range measurements every five minutes, each having first held up her "corrector" for the range-finder of the other ship. Then each telegraphed her measurements to the other ship.

The wind, that day, was marked in the log as 3 to 4, and the sea as "moderate." The speed was 11 knots and the wind was on the starboard bow. The conditions for range-finder work at sea seemed average, except the rate of change of range, which was much greater than would probably occur in battle, being 162 yards per minute.

There were 13 observations varying between 2040 yards and 7300 yards. The average disagreement between the range-finders was 33 yards, and the square root of the average of the squares of the ranges was 4874 yards. That is, the disagreement between the two range-finders was 33 yards at 4874 yards.

It is mathematically probable that the true ranges were somewhere between the measurements given by the two range-finders; that is, that the average error of the two range-finders was probably 16½ yards at 4874 yards; which is 25 yards at 6000 yards.

It may be objected that the true range may not have been between the readings of the two range-finders, because both range-finders may have read either over or short. This, of course, is true; but if so, the reason was simply that the marks on the "correctors," which were made on board the *Tennessee*, may not have been placed at exactly the right distance apart; but this would be an error wholly remediable, because the Washington Navy Yard could easily make correct correctors.

However, I had the accuracy of our corrector tested at a known range, when the ship anchored at Panama, by sending our corrector on board the *West Virginia*, correcting both our range-finders by it, and immediately thereafter taking twenty measurements of the distance of the cathedral with each range-finder.

Mr. Russell took these observations, and the mean of twenty observations with the Barr & Stroud range-finder No. 883 was 6949 yards; and with range-finder No. 882 was 6956 yards. The average disagreement of the readings of range-finder No. 883 with its own mean, was 11.8 yards; of range-finder No. 882, was 14.9 yards. The range of the cathedral, as measured from the chart, our position being plotted with the utmost care, was 6925 yards. Mr. Russell took every precaution against self-deception, being honestly anxious to ascertain the truth.

The difference between 6925 yards and 6956 yards is 31 yards; and the error corresponding to 31 yards at 6925 yards is 23½ yards at 6000 yards.

The writer feels justified in concluding therefore that, *with an amount of training no greater than that given a gun-pointer*, the error of the range-finder method, used at sea under average conditions, may be assumed to be about 25 yards at 6000 yards; and the error of the spotting method to be at least 122 yards at 6000 yards.

This takes no account of the fact that the range-finder is an instrument that can be improved, and that one can practice with a great deal at sea; or of the fact that it is impossible to get any practice in spotting at sea.

Thus far, no mention has been made of any factor except accuracy.

Therefore, it may be objected that, even if it be granted that the range-finder method is the more accurate when no guns are firing, yet the range-finder itself is liable to be jarred out of adjustment by the shock of gun-fire.

To this may be replied that—

(a) The turret range-finder mounted on top of the turret of the *Arkansas* was not jarred out of adjustment when five 12-inch shots were fired, on April 15, 1907.

(b) The range-finder of the *Tennessee* was not jarred out of adjustment at her battle practice in November, 1908. Of course the shrouds and stays of the lower mast and topmast were set taut and the pedestal of the range-finder was carefully stayed.

(c) It is easy to make a range-finder so strong, mechanically, that it could not possibly be jarred out of adjustment.

It may also be objected that the vibration of ship during gun-fire is so great that no observer could possibly get range-finder readings.

To this it may be replied that there must be occasional "cease firings," in order to ascertain the range, no matter what method be employed. When using the spotting method, it is necessary to wait after each turret shot or salvo, until the splash is seen, before any correction can be made to the last sight bar range, say 10 seconds; similarly when using the range-finder method, a new measurement can be begun in less than five seconds after the discharge, and completed in five seconds more—under average conditions. This ten seconds is not time lost, in either case, because during this time, the guns are being loaded.

POSTSCRIPT.

Since this article was mailed to the Naval Institute, it has been pointed out that the article may be construed as advocating the abolition of spotting. The article does not advocate the abolition of spotting.

The writer believes in spotting; that is, in having observers above the smoke, who tell, from the fall of the projectiles, whether the range used was too small or too great.

He believes, however, that spotting should be auxiliary to range finding; not that range finding should be auxiliary to spotting.

It seems to him that the principal rôle of spotting is simply that of raising or lowering the mean point of impact, by correcting for some *actual* change of I. V. of the index of powder being used, *if it occurs;* or some change in the "coincidence adjustment" of the range-finder, *if it occurs;* or for both.

So why not use spotting simply to regulate the coincidence adjustment of the range-finder (or range-finders) and raise or lower the mean point of impact in this way? This can be done by a simple mechanical device.

The danger of depending upon spotting alone may be seen, when we recognize the fact that, if the enemy has good range-finders, and if the enemy's admiral, after the fleets are drawn up in parallel columns, will carry out the well-known "follow my leader" tactics, changing the course of the leader back and forth, say one point each side of the middle course, he will change the range irregularly and frequently, back and forth, about 93 yards a minute; the fleet speed being here supposed to be 15 knots.

The gradual changes of course and distance will not bother the enemy's range-finders, so they can keep our range all the time; but on our lofty and exposed fire-control platforms, our armies of spotters, change-of-range-projector-men, and telephonists will not be able to find and transmit correctly the sight bar range.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE SCHOOL OF THE CAPTAIN.

By REAR-ADMIRAL CASPAR F. GOODRICH, U. S. Navy.

Again I open my professional note-book, in the hope, rather than the expectation, of extracting from it something which may help my colleagues in solving some one of the many problems with which the present generation of naval officers is confronted. In so doing, my mind is carried back to the early days of my course at the Naval Academy, when I studied text-books differing as much from those of the present day as the ships of now differ from those of my youth.

One manual, in particular, always gave me pleasure with a large admixture of amusement. I refer to Hardee's Infantry Tactics. This code for the instruction of soldiers, brought over from France in the fifties by Captain Hardee as the result of an inquiry into French methods, was the basis of all the movements in our own army up to the outbreak of the Civil War. A revision was then issued, bearing the name of Lieutenant-General Winfield S. Scott, the commander-in-chief at that time. It was first Hardee, and afterwards Scott, from whom we midshipmen gathered an idea of the way in which war was waged, and insensibly we acquired the habit of regarding precision as the most important of all the elements entering into drill. I have forgotten how many "times" were required for loading the rifles of those days. I do recall the fact that a great advance was considered to have been made when this number was reduced to nine and the order changed to read "Load in nine times!" "Load!" "Handle cartridge!" "Tear cartridge!" "Charge cartridge!", etc. Of course any "time" might again be subdivided into a number of "motions"; for example, "Draw rammer!" could not legitimately be done in less than three "motions," as any reader will admit. Now-a-days rammers are things of the past and, instead of tearing the cartridge between the teeth and pouring the contents down the

muzzle, we open the breech by a turn of the wrist and shove the cartridge in. None the less, it is clear to me that the respect and admiration which all felt for this manual of arms may serve a worthy purpose and hold out a valuable lesson even at this late date. Were not these very injunctions as to precision of great use at that time, since in them began the school of the soldier, followed by the schools of the squad, the company and the battalion and ending in the schools of the regiment and the brigade? Battles were conducted in the most formal manner then and regularity was incumbent on all who played the splendid game. For my part, I am sure that a great deal worth while was secured in this way, even if much chaff was mixed with the grain. It is always possible to winnow out the former and keep the latter. There also remains the appreciation of the necessity of drill, even though the drill fashions of the moment differ *toto coelo* from those of my boyhood.

It was never believed, even in those days, that between the covers of Scott's Tactics was to be found everything relating to the conduct of a campaign—quite the contrary. That the manual of arms and the movements which Scott elaborated and taught, fitted the troops in the field to carry out the wishes and plans of the commander-in-chief was strongly held, even to the point of regarding them as essential. As to this, doubts were entertained then which have since ripened into certainty.

The question has often arisen in my mind whether a manual, so to speak, is not needed to-day by the navy. I do not mean the instruction of the individual sailor, for his education is already extremely well cared for, through a number of schools in which we prepare recruits to fill the exact place on board ship they are destined to occupy, and through the team work which has brought our divisions up to such a marvellous pitch of dexterity and efficiency. We do this through no sentimental fondness for the individual, but because the special talent which we desire can only be obtained by enlisting promising and intelligent young men and then moulding them to fit the special requirements of our own necessities. In many ways the educational methods of our service are the admiration and despair of others; and they leave little to be desired, whether they relate to the junior officer or to the men. Has it ever struck my colleagues that, having gone thus far and having fitted those of lower positions for as satisfactory

a performance of their duties as it is possible to obtain, we have halted at the final step and have failed to crown our scheme by the establishment of schools for the captain and the admiral? Every other man in the navy is taught to perform, and to perform well, his particular task, but the captain, going on board to take command of a battle-ship, a craft the like of which he may never have served on before, is at once deemed competent *de facto* to carry his vessel into the line of battle and hold her there. Yet, speaking generally, he is denied the opportunity to develop the ability to manage his vessel as she should be managed; and, except through a vague undercurrent of opinion running through the fleet, nothing positive and tangible is really known of his fitness for his responsibility. It is hardly necessary to add that the captain, notoriously "ship-shy," is not referred to, while, even with him, clean-cut facts are quite lacking.

Is this lack of perspective and this misapprehension of a crying need in the navy due to an unwillingness on our part to admit that there is something for us to learn, or is it because no Hardee or Scott has come to the front, bearing in his hand a system by which this important—indeed, one might well say, this *most* important—branch of the naval art may be inculcated? Should this be the case, then it is incumbent upon some one to provide what is lacking.

Possibly my note-book may be drawn upon for a slight contribution towards the composition of what seems to me to be a much needed work. It is in this spirit that I offer to my fellow officers a few suggestions under this head, hoping to induce wiser and abler men to expand them into a code which may easily prove the deciding factor in time of battle.

The discipline and routine of the man-of-war, fixed as they are by the laws, regulations and traditions of the service, are assimilated *pari passu* with the performance of duty. That part of his responsibility the new captain is quite ready to discharge faithfully and well, but for the actual handling of his ship he must trust to experience gained in smaller and more nimble craft. This is very good so far as it goes but it is not enough. The skilled chauffeur or yacht skipper is a development, not a creation. To get expert battle-ship skippers we must train the aspirants systematically and uniformly, *we must introduce the invaluable feature of competition*, and we must weed out remorselessly the man who, after

a fair trial, is found to be constitutionally deficient in nerve, in quickness of perception or in that indefinable something which is imperatively demanded on a ship's bridge on occasions of emergency.

I take it that this matter, while delicate in its nature, presents no real, inherent difficulties. To my mind, it implies a scrupulous regard for the rights of the individual and a no less scrupulous regard for the rights of the government, now almost habitually ignored.

Summarily to whip a captain out of his ship for a cause not based on his physical or professional incapacity, or on his misconduct, is to work injustice with unreasoning hand. To replace him by a worse man, while screamingly funny, works equal injustice to the government as does the retention in command of a captain deficient in those faculties upon which success in action may, indeed must, hinge. In other words, it is the undoubted moral right of the most capable, of eligible rank, to have the best duty assignments, and it is the undoubted right of the government to have its most capable men in those best assignments. What I am seeking is an automatic and impersonal method of determining the real, and not the fancied, worth of each and every battle-ship captain.

I hold it to be a *sine qua non*, that the final proof of an officer's merits should rest on ascertained and recorded *facts* and not at all upon the *opinions* of any person or persons.

It is far from my intention to lay down a complete scheme. If the general plan meets with the favor of the service at large, the details can be filled in with the greatest ease. What I propose resembles, if faintly, the old methods of Hardee and Scott. "Progressive instruction" is the key-note. Let me run hastily over the steps I believe to be necessary.

As soon after the new captain assumes command as the ship is able to move, let him take her alone to Gardiner's, Cape Cod or Magdalena Bay, or some equally favorable and isolated locality, there to spend a fortnight or a month in learning her ways and in doing practically those things which, in the fleet, give a vessel the reputation of being "smart." Getting under way quickly, coming promptly and accurately to anchor on prescribed bearings, picking up moorings, evolutions: these reflect the skill and energy of the man on the bridge. In lesser degree may be cited running

lines, rapid signalling, suddenly calling away a boat and getting her off from the ship in less than three minutes, etc. These latter are useful exercises; but while they add their mite to the whole, since they involve others as well, they are not such intimate reflections of the captain's own individual capacity as is what he does when alone on the bridge itself.

Our skipper has now had his undisturbed chance to find out how to drive his team. He joins the fleet, takes his place in the line and acquires, or fails to acquire, the knack of holding his position and of manœuvring along the turning arc which the commander-in-chief has adopted for all. In the mean while his crew, through competition, is striving to excel in those things common to all and performed in sight of all.

After three months spent in the fleet, of which not less than twenty days under way, the captain is "inspected." The inspection which I advocate is not that of the ship, with which we are familiar, but a keen, careful and practical examination of the officer in command. It should be repeated once every six months. Upon it will be largely based the semi-annual "Report on Fitness." For the sake of brevity and clarity, I will use the present tense.

A board is appointed of three officers senior to the captain to be examined. Preferably they should be flag officers from other fleet-divisions than his. They are provided with observers in plenty. The latter have stop-watches and record-blanks.

Ample notice of the board's coming having been given, the ship has steam up and everything in readiness.

Out of the many appropriate tests which will occur to any reader, I give a few to illustrate my idea. In every case (except specially noted) the captain must be the only officer on the bridge.

1. UNMOOR SHIP! Time is taken from the instant the order is given to

a. The mooring swivel off.

b. The designated lee anchor on the bill-board, or hove in and housed.

c. The riding chain shortened in to the original scope.

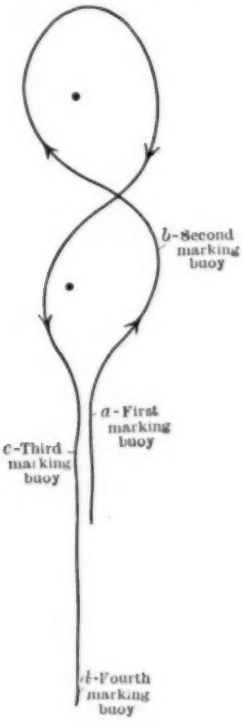
2. GET UNDERWAY! Time taken as before to

a. Anchor housed or on bill-board.

b. (If headed up stream) Ship winded and headed down stream.

c. Making 15 knots.

3. Two buoys having been planted, say 500 yards apart and directly in the line of the course, approach at the rate of 15 knots, make a figure 8, the loops being about the buoys and the course crossing between them, and steam out again.



a. Time taken and a marking buoy dropped when the helm is first moved to swing the ship out of her course.

b. Time taken and a buoy dropped at the instant of first altering speed of either or both engines.

c. Outside observers angle on the ship every minute and plot her route afterwards on tracing cloth and to a standard scale.

d. Time taken when ship is back on her original course, third marking buoy.

e. And when steaming again 15 knots, fourth marking buoy.

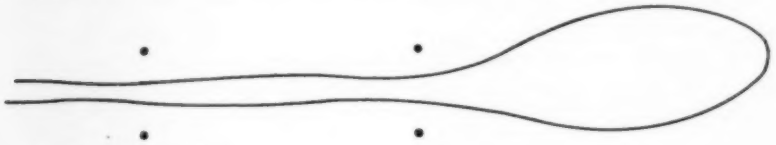
A comparison of the times and routes of various captains in this connection will quickly show which is the most and which the least competent. A composite blue-print would be particularly instructive. This remark will apply to other cases as well.

4. Plant four buoys in a rectangle 60×400 yards—the length of the rectangle along the course. Approach at 15 knots; steam through this lane; turn around beyond (in any way the captain pleases) and steam out again.

a. Take time and drop a marking buoy when the engine-room telegraph is first touched.

b. Plot the ship's track as in 3 by outside observers.

c. Take time and drop a marking buoy when completely turned around and steaming back over original route at 15 knots.



5. Come to anchor.

a. Plant a marking buoy at the spot where the anchor is to be dropped.

b. Approach at the rate of 15 knots.

c. Take time and drop a marking buoy at the first change of speed.

d. Outside observers plot the track of the ship.

e. Take time when anchor is dropped, outside observers noting the distance of anchor splash from buoy indicating place where anchor should have been dropped.

6. A similar test with the exception that the spot is indicated solely by cross bearings or by a bearing and a distance. In this instance officers may be on the bridge to take bearings and angle for distance.

7. Moor to a buoy. Plant a stout mooring carried by a wooden float, say 10 feet square.

a. Approaching at the rate of 15 knots, drop a marking buoy at the instant of touching the engine-room telegraphs.

b. Outside observers plot the track of the ship.

c. No boat to be lowered. Take time of a man's jumping on the buoy (a member of the inspecting board to be at the ship's bow and permit the jump when in his judgment not unsafe).

d. Time taken when reeving line is passed through ring of buoy and end back on board.

e. Time taken when ring rope (strong enough to hold the ship) is rove, end back on board and made fast.

f. Time taken when chain is shackled to buoy.

g. Time taken when all men working on the buoy are back on board. (They may be taken off by a boat.)

To these exercises others can readily be added. The crux of the matter is that each captain makes his own record, for the sheet reporting his performance gives bare statements of fact and quotes no opinion. By that record he must stand or fall. It will then suffice for a commander-in-chief to write to the Navy Department somewhat as follows:

"As the record of practical examination of Captain Blank clearly shows his professional inaptitude, I have the honor to request that he be detached and another officer sent in his place."

If these tests be found satisfactory and valuable in the case of captains, the next move will be to bring out "the school of the admiral" on similar lines. Like the other it is, in my judgment, sorely needed.

I need not dwell upon the bracing-up our captains would thus experience, nor tell how the skilful among them would welcome such an opportunity to establish their own capacity beyond peradventure. The temperamentally unfit, on the other hand, would write their own condemnation. Officers would soon realize that their future lay mainly in their own hands and but little in the wholly adventitious and frequently mistaken favor of superiors on shore. The majority of our captains are eminently worthy of their commissions and commands, but our traditions have put them on the same dead level of mediocrity with (if not below) others who are better known to the service by their desk work than by their real knowledge of the profession, with which some may be said to have only a bowing acquaintance.

It is a matter of poignant regret to many that so much time in the past few years has been wasted by our fleet in neglect of that actual work of the service which it alone can perform and through which a juster estimation could have been formed of the professional attainments of its commanding officers. For guesswork and individual conceptions, it is time to substitute the demonstrated fact and impersonal judgment; for the rule of thumb, the procedure of modern science, timing, measuring and recording with no interest in the result other than to secure absolute truth.

For the incompetent I offer the "knife of honorable despatch" with which to commit official hara-kiri, and to the competent the chance to write their names on the roll of efficiency just as high as their technical stature will permit—and no higher.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

ON OTHER DUTY.

By COMMANDER GEO. R. CLARK, U. S. Navy.

"... and such other duty as may be assigned."—*Old order.*

On the morning of June 17, 1900, six gunboats, one English, one French, one German, and three Russian, engaged the Taku forts at a distance of about one mile in the second reach of the Peiho river; that is, around the first bend, a narrow neck of land intervening between them and the forts. This position was held from one o'clock, when the battle began, until daylight. Then about seven hundred sailors landed and made an unsuccessful attack upon the works. Things were beginning to look gloomy, ammunition was running short, and the guns of the forts were still firing as actively as at the beginning, when Captain Stewart, of the English gunboat, *Algerine*, proposed to the commanding officers to go around the bend and engage at close range—from one to two hundred yards. This bold plan was at once carried out; the machine guns drove the Chinese from the batteries, and under cover of this hot fire the landing party made a second assault and this time was successful. A lucky shot from the *Algerine* entered the magazine at the south fort, which blew up with a terrific report, killing hundreds of Chinese soldiers. This catastrophe seemed to dishearten the enemy, for soon after the flag was hauled down and the place was abandoned. Meanwhile, the Japanese, who had gained possession of one of the forts on the south side of the river, turned the big guns upon the north fort, still held by the Chinese, and drove them out. By half-past six the flags of England, Russia, Japan and Germany were flying over the works, and the enemy's troops were in full retreat to the southward. The Taku works were captured, and that day the Imperial troops threw off the mask, took the side of the Boxers, and attacked Tientsin.

The Japanese gunboat *Atago* and the U. S. S. *Monocacy* took

no part in the bombardment, the former on account of being laden with ammunition and provisions for the allies, and the latter being held by instructions from the commander-in-chief, which, taking the ground that we were not authorized to initiate any act of war with a country with which we were at peace, confined our work to the protection of American interests. Accordingly, on the evening of the sixteenth, the residents and refugees of Taku and Tongku were directed to embark for safety at once on board the *Monocacy*, then lying in what was thought to be a sheltered berth at Tongku. Nothing loath, seven men, thirteen women, and sixteen children abandoned their homes and hurried on board.

W. Savage Landor, writing of the incidents of that time, speaks as follows: "On the bridge of the *Monocacy* stood her commanding officer, encouraging the women and children swarming the decks, who, all the same, felt some apprehension at the hissing and bursting of shells, fortunately high over head. He and his officers reassured the refugees and tried to convince them that the ship lay in a position of safety, when, much to everybody's surprise, she was hit by a shell that cut right through the bows."

To have regarded that stray shot as a declaration of war on the part of China, to be resented then and there, would have meant the casting off of lines and going into the fight with several dozen women and children on board, a somewhat unusual proceeding, a fact that even the most strenuous advocates of glory at any price would have to admit. It was equally out of the question to land the refugees and turn them over to the tender mercies of the roving bands of robbers who had already begun their work of looting, robbing, and killing. War, in one respect, is like a certain well-known institution, which, we are told, should not be "entered into lightly or unadvisedly," and, at any rate, should not depend for its cause upon the exact location, whether a few yards to the right or to the left, of the fall of a stray shot. There is no time to back and fill about boarding a train after the train starts. The question of going or staying should be settled long before the engine pulls into the station. Then, too, innocent onlookers at a street fight have themselves to blame if struck by missiles going wide of their mark. Their plain course, in that event, especially if they have children in their arms whom they are unwilling to throw away, is to get behind a bigger tree. The truth is, we had been given a rôle and had to stick to it. The commanding officer in his official

report said: "I feel a natural regret, shared no doubt by the officers, that duty and orders prevented the old *Monocacy* from giving her ancient smooth-bores a last chance."

In this connection it may not be amiss again to quote from Landor: "It is pleasant to notice that, whatever the orders from the government in the matter of co-operating in the engagement at Taku, the feelings of the United States officers themselves on the gunboat did not differ from those of all the other officers of the allies."

After the fall of the Taku forts, at a meeting of the admirals on board the *Rossia*, a protocol was signed that placed the commanding officer of the *Monocacy* in control, in the town of Tongku, of all the buildings, the railway station, the water supply, rolling stock, etc. In this he was to have the assistance of an officer from every nation for the purpose of transmitting orders to whatever detachment might be using the station.

Then our work, the work that compensated in a measure for our enforced inactivity in the early part of the trouble, began. Taku had fallen but Seymour's column was yet to be relieved, and Tientsin, defended by only seven hundred troops (including thirty from our gunboat), was hard pressed by several thousand Boxers. The problem (Chinese puzzle) was to send the fast-arriving allies to the front over the torn-up, single-track railway between Tongku and Tientsin. The commanding officer turned the duty over to me with the remark that "the road must be put in commission at once," a task simple enough, no doubt, for a railroad expert, but somewhat of an order for a seagoing man with seamen for his operating force! However, the time was short, and after a hurried inspection of the rusty locomotives and weather-beaten cars left in the yard, I called the short-handed crew about me and told them the story. In less than two days five locomotives were in commission ready for use, four manned by our people and one by the English. Trains began running with American conductors and brakemen, and the work was on.

That it was essentially an American service, the following extract from an official report will show: "The employees in this make-shift train service are all my own, with, at first, some English and German firemen and stokers . . . . I tried to induce a civilian employee of the railway to go out with the train which has just left. My men were on the engine. I tried my best, but

he had recently escaped from Tientsin, and said positively he 'would not risk his skin again anywhere near those Chinese devils.'"

Following the good old service custom, before making any through runs with the locomotives we sent them on short shaking-down cruises, or trial trips, which were pronounced highly successful if the train kept the track and crept back into port without serious accident. The result was particularly pleasing, I remember, when the engines got back under their own steam, without the aid of the relief engine that was kept ready, night and day, to tow in any cripple suffering with leaky tubes, water famine, or hot boxes. The orders were to play for safety. We didn't break any records, nor, on the other hand, did we break any legs. A burst of speed would have meant a burst of boiler. I tried to impress upon the train crews that the race is not to the swift but to the careful. If any of our trains had been named Cannon-ball Express it would have been on account not of the speed but of the nature of the cargo.

Between trips search was made in the yard for anything that might be useful in our work. At first nothing came of it. Looted cars, scattered bales of goods, and scrap heaps could not be utilized. Finally, however, a private car, travel-stained and forlorn-looking, was found, hauled to the front, and filled with coolies armed with brooms and scrubbing-brushes. That discovery solved the problem, which up to that time had bothered us, of providing suitable transportation for officers of high rank. Anticipating the time when the telegraph lines would be desirable, we loaded (while we were resting) several cars with telegraph poles found in the yard and along the road, so that when the Japanese volunteered to rebuild the telegraph line everything was ready. I remember that there were three, just three, poles left after the cars had been unloaded along the track between Tongku and Tientsin. Nor shall I forget the astonishment of the captain at my reply to his question, asked in the presence of the Japanese, as to how many days it would take to find poles and have them ready to distribute along the track. "They are ready now, sir; the relief engine can start up the road with them in ten minutes."

The rolling stock of that road not being designed for the transportation of military supplies, it was found necessary in many cases to change the style of architecture of the cars. Then was

shown the advantage that sometimes comes from combining several departments under one head. Being chief of construction, of equipment, of supplies, and of the ship's carpenter gang, I found no red tape in the way of an easy solution of the problem. The carpenter's gang did it with axes and saws. When the openings were not wide enough for horses and carts, we made them wide enough. This was hard on the property, of course, and would have brought tears to the eyes of the railway men, but they were not there to protest, and something had to be done. It was a situation that demanded acts before words.

One of the plans that worked well was the sending of trains in two sections, the first with troops, the second, about fifteen minutes later, with horses, wagons, tents, stoves and ammunition, with orders to take the side-track near the terminus until the return of the emptied first section, and then proceed to the end of the line, where the waiting troops assisted in unloading. A few general rules like the one just mentioned worked automatically in a few days, and gave us time for other things.

The value of the service rendered by the *Monocacy* in supplying fresh water to the troops cannot be overestimated. The captain in one of his official reports said: "I have also sent out two platform cars containing large fresh-water tanks, each with a capacity of about 5,000 gallons . . . . I have been especially careful that every train and every car carried drinking water in small utensils, breakers, buckets, cracker tins, *as there is no potable water between here and Tientsin.*" The italics are mine, and tell of the greatest danger and difficulty with which we had to deal.

The asthmatic sentences of the log-book covering that period, together with the story between the lines always, in such books, plainly visible to the seagoing man, tell of busy watches, of obstacles overcome, of assistance given, of hard work done:

Midnight to 4 a. m.—Heavy-gun firing started at E'd at 12.45. At 1.30 the *Iltis* left harbor. At 2.35 a projectile struck 2d cutter, passed through stern and sides of same, then over the stbd. bulwarks and through port bulwarks at break of forecastle, five feet from deck, and did not explode. Small-arm firing occurring at intervals and singly from shore in vicinity of this vessel. Several shells passing over and bursting in vicinity.

8 a. m. to Merid.—Engaged cleaning locomotives and making up train. Refugees left ship, but finding conditions at Taku unsettled, returned. Surgeon gave assistance to three wounded (1 Chinaman, 2 Russians).

Distilling. Vice-Admiral Alexieff visited the ship. Despatched train of 28 cars with troops, horses, ammunition, and 10,000 gallons fresh water. Sent armed party up river and took possession of a large seagoing tug. At 9.35 Lieut. I., of this ship, left for Tientsin, with 22 men, gatling gun, carriage and tripod mounts.

Merid. to 4 p. m.—A train arrived at 3 and reported 2 locomotives disabled. Brought in same and made preparations for sending up another train. Filled water tank and sent to front together with a repair car. Sent to train for use of English naval force 1 3-in. B. L. R. and ammunition.

Midnight to 4 a. m.—Sent assistance to Japanese torpedo boat aground in the river. At 3.15 despatched train with Russian troops. Relief engine brought back disabled train. Distilling. Heavy firing in direction of Tientsin. Made special preparations to resist threatened attack of Boxers.

The log-book, too, served to tell when Sunday came. There was no church bell to ring out glad tidings of "peace on earth, good-will toward men"; but this was just as well, perhaps, for the call of the bell would have been but faint in all that din telling a story so different.

Although things ran along smoothly, we were not wholly free from worries. The cares that infested the day, instead of folding their tents and stealing away, often remained over and stood the night-watches with us, when they took good care that we did not sleep on post. Indeed, our wrestling matches with the little god of sleep in that busy time were of the catch-as-catch-can variety. Trains were sent up the road at night as often as during the day. The situation was much like the one that called forth the old-time order of the boatswain to the busy crew, "Turn to while you are resting and break out the fore hold!"

However, we luffed through the blue days with thoughts of the compensations—the many letters of thanks and appreciation, official and private, received by our commanding officer from the commanding officers of the various bodies of troops we helped to the front; the remark of the English captain, made in the presence of a group of foreign officers, that Tientsin would not have been relieved, had it not been for the American gunboat; the satisfaction that comes with taking part in work that counts, work that grows in ease and interest; the remembrance that, although Napoleon's despatches always contained the word glory, Wellington's favorite word was duty—all these helped. Perhaps our satisfaction would have been even greater had we known then that our commanding officer was to be decorated by the Emperor of far-away Germany with the Third Order of the Red Eagle. To get the

correct view of a picture, it is sometimes necessary to look at it from a distance.

The work, while trying and difficult, was not without its amusing incidents. I had an interpreter (a seaman from the *Monocacy*) close alongside all the time, who spoke all the known languages. He needed them. I sometimes thought he would lose his mind—or his tongue, but he lived through the trouble, and at last accounts was sorting out his languages in an attempt to get them straight again. His name should go on record, for it fitted him. It is Gold.

"Sir," said a foreign officer, "I should like to have a train Wednesday morning at six o'clock for seven hundred troops and one hundred horses."

"Very well, sir," was the reply, "the train will be ready." And then, in an undertone to my messenger, "Ask the engineer of No. 3 if he thinks he can make one more trip without blowing up the boiler."

"Is this the ten o'clock train?" I was asked one busy morning.

"No, this is the Tuesday train." Ten o'clock train, indeed!

The noise of the moving cars was not so loud as to prevent the general manager from hearing some of the remarks of his subordinates. "Bill," said an engineer to the ordinary seaman then acting as stoker, "do you think we can make the run to Tientsin without a compass?" "Oh, ask the coxswain about that," said Bill, as he threw another shovelful of coal into the furnace. Fortunately these pleasantries were all in English and passed unnoticed by the busy strangers.

But underneath it all, those of us who knew those faithful men could detect the earnestness, the close attention to detail, the determination to succeed, that mark the bluejackets' conduct in time of trouble, and win their officers' confidence and regard. Cheerful, obedient and efficient, working night and day, they were a source of pride to their people and of wonder to all foreigners.

The operating of the Chinese railway under the conditions existing that memorable summer is more simple in the telling than it was in the doing. It involved more than appears on the surface. To keep the wheels turning, many things had to be thought of. The number and condition of the cars available for use; the number of troops, horses, carts, boxes of ammunition each would hold; the locomotives and the number of loaded cars each could pull;

the position and length of the sidings; the water supply for the engines; the best means of loading and unloading horses and carts; the way to avoid giving offence and to preserve strict impartiality when two bodies of troops of different nations wanted a train at the same time—all these questions and many others clamored continually for prompt answers.

Under these conditions it was not conducive to clear thinking or quick decision to hear, as we often did, that the Chinese were assembling in the vicinity with the object of making an attack upon the yard. The train crews were always armed. The best excuse given for a late train was that of the boatswain's-mate conductor who said that he had stopped to get a few good shots at a body of Boxers intent upon placing obstructions on the track.

Our hammer-and-tongs measures afterwards met the approval of the real general manager of the road, who, on his return from exile, laughed heartily when told of the unique methods of nautical railroading, and remarked that "the system, though unusual, has evidently been successful."

No, it was just plain, very plain, every-day railroading, without fancy frills or flourishes, but it did the work given it to do. When, after several weeks, the breathing spell came, and we found time to get an all night in, it was pleasing to know that not a man had been delayed a minute, not a limb had been broken, not a car had run off the track, not a life of man or beast had been lost. Thirteen thousand troops, several hundred horses, camp equipage, ammunition, provisions, water—everything for the maintenance of the armies, had been sent up over a rickety, single-track railway, which, weeks before, had been abandoned by its people to the kind attentions of Boxers and roving bands of robbers—this by a group of bluejackets from our smallest gunboat.

Things, live interesting things, happened with sufficient frequency to drive away all traces of *ennui*. Soon after the capture of the forts the foraging party of one of the allies collided with the party of another ally and robbed them of their provisions. Whereupon the commanding officer of the defeated people buckled on his sword, went over to the neighboring fort, and asked questions. The accused, not to be outdone in promptness and politeness, then and there stood the identified offenders up against the mud wall of the fort and had them shot. That closed the incident. On another occasion a zealous officer asked for a coolie then acting

as aid to one of our locomotive firemen, with the declared purpose of depriving him of his head. When refused on the ground that, for the time being, the coolie was an American, the officer went away shrugging his shoulders and wondering, no doubt, at the foolishness of those who do not in war time act upon the good old rule, "whenever you see a head, hit it." At another time a squad of six or seven held a merry little target practice of their own, the target being the head of a Chinaman swimming across the river. The exercise, from its deliberateness and the range-finding shots, seemed to be record rather than battle practice. When ordered away the marksmen seemed unable to understand that the unarmed Chinaman was a non-combatant, and, as such, not eligible for use as a target. It was another case of hitting the head. A favorite custom of one of the allies was to scour the country for coolies for camp work, and to bring them in in squads, or bunches, of four or five with their queues tied together. This plan was somewhat awkward for the coolies but economical for the troops. One corporal could do the work of several men. The motto seemed to be, "United they come, divided they run." Kid gloves were not in fashion at Tongku. Owing to the scarcity of furniture in the home-made hospital at Tongku, where I served a short term, the only table did duty in both the dining-room and that other room for which hospitals are built. Often our meals were hurried in order that the table might be put to its legitimate use, which, of course, always had the right of way. There was no time for walnuts and wine. Turning from the table to the window, one looked in vain for the pleasant surroundings so helpful to hospital patients. There an ugly picture met the eye—a dreary, dust-covered, sun-scorched plain, and a sluggish river on which things unspeakable, seen only in war time, steadily growing in number and unpleasantness, turning lazily in the eddies, shining brightly in the sun, floated slowly, always slowly, until caught and held by projecting banks, where they became the prize of snarling, unclean, half-famished creatures. Truly, no day passed without incidents that brought to mind Sherman's terse definition of war.

The fatigue of the day was often driven away by the fine singing of the soldiers encamped for the night near the station. In the evening a single tenor voice, taking up the words of a song, usually those of a national hymn, would be joined by others at the

more distant posts, until one grand volume of sweet sound was carried in the still night air far out on the plains, taking to the ears of the wondering Boxers news of the coming of the modern crusaders. Nor was this open-air concert without a proper stage-setting. The curtain rang down each night to the accompaniment of sweet music, soft twilight, and the soothing calm that comes with night-fall on the plains. But O, what a difference in the morning! The rise of the curtain next day revealed the presence of the men with spears, the shield-bearers, the noise-makers, the soft music displaced by discordant sounds, while the crack of the rifle, the sound of the axe, the cry of the Chinaman, gave evidence that the work of benevolent assimilation, the march of civilization, had been resumed.

There was plenty of time to note the differences in equipment, discipline, and organization of the several companies that passed up the line—Sikhs from India, French from Annam, the First Regiment of Chinese from Wei-hai-Wei (fighting for the English under English officers), Germans and Italians, Japanese and Americans, Russians and Austrians—all against China, the West against the East, the newer civilization against the old. The bearing of the Russians was suggestive of strength and courage, and the Japanese, while not lacking in these qualities, were remarkable for their careful attention to detail, splendid discipline, and matchless organization. They were quiet, polite and observant. The Sikhs, once seen around their camp-fires, can never be forgotten. Tall, dark and mysterious, they have the faces of poets and the manners of masters of the occult sciences.

Although our bluejackets are not in need of testimony as to their fitness, some of the preceding paragraphs may serve to show what can be done by the crew of a small gunboat when suddenly confronted with problems not in the book. I dare say that all work that has to do with armed conflicts should be either war or magnificent. This task surely was not war, nor could we console ourselves with the thought that it was magnificent. Its service was that of the only bridge across a swollen stream to an army on a hurried march. The timbers, straining in the dark far from the lime-light, creaked and groaned, at times, under the weight of the martial hosts, but remained in place until the last man was over. Then, the work done, the bridge was dismantled, and the various parts were stowed away, but not too far away, I trust, to hear the next assembly call.

LT. ROSWELL H. LAMSON

1867

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

LIEUTENANT ROSWELL H. LAMSON, U. S. NAVY.

By F. P. B. SANDS, Formerly Acting Master, U. S. Navy.

A recent bulletin issued by the Navy Department announced that one of the new torpedo-boat destroyers was to be named after the late Lieutenant Roswell H. Lamson, United States Navy.

The bare announcement conveyed no information as to what were the services rendered by that young officer which merited such a distinguished honor.

As a shipmate and intimate friend, associated with Lamson on duty during the period when he most distinguished himself, it is a pleasant duty to detail the incidents of his career, which will demonstrate how worthy Lamson was of receiving even far greater honor from his government.

Roswell Hawkes Lamson was born in Iowa on March 29, 1838, his parents being Jeremiah and Helen Hawkes Lamson. In 1847 his parents joined those venturesome pioneers who with ox-teams crossed the wild plains of the west and, boldly passing beyond the Rocky Mountains, descended their western slopes, and then, passing over the Cascade Range to the banks of the Willamette, located in and settled upon the soil of Oregon, then a veritable waste.

Young Lamson was then but a boy of nine years of age, but the hardy life and the fatigues of that overland trip, with its frequent and long marches from camp to camp, at times on foot and at times on horseback, brought vigor and strength to his limbs, and he grew sturdy and full of strength and perfect health. The trying experiences of all that, to him, very eventful trip—with its constant alarms from the threatened attacks by the Indians whose territory they had to cross, the night-watches, the scouting parties watching over the welfare of the train of emigrants, the constant association with men inured to such lives of daring—

tended to develop the mind of young Lamson, to make him thoughtful and serious beyond his years, taught him self-reliance, and gave him a degree of confidence in himself that manifested itself in the emergencies of his eventful career later on.

Often, during the night-watches on the blockade service during the War of the Rebellion, Lamson, at one time my messmate and later my commanding officer, would walk the deck with me, describing the incidents of those days of his boyhood. He told of the settlement of the country where his parents and their friends settled in Oregon. He described the clearing of the land for cultivation, the upbuilding of the little community in which they were to live and the hardships they encountered. He narrated in simple, but vivid, language the organization of the settlers for mutual protection from the Indians who, in their forages, sought to drive them away.

He described the events of one such experience when he, a boy under fourteen years of age, went out with a large body of the settlers to check a band of Indians who were threatening the neighborhood. They searched the country, driving the Indians before them. With all the eagerness and impetuosity of youth he had forced himself ahead of his party out into the open, when suddenly, about fifty feet from him, up rose a painted savage who was about to let fly an arrow at him. Lamson said he was all taken aback and forgot to use his rifle, but just stood and looked at the splendid specimen of manhood before him. The crack of a rifle back of him and the whistle of the bullet close to his ear brought him to a realization of his danger. He raised his own rifle but did not fire. He saw an expression of horror pass over the warrior's face, his bow was undrawn, he stood for a moment rigid, then with a sigh plunged forward, falling face down, and he was stone dead when they reached him, the bullet of the scout who had been so prompt having pierced his heart. This was the closest call Lamson had in those days.

He was studious, and his parents were evidently earnest in their religious belief, for their son always showed great devotion to his religious duties.

On September 20, 1858, he was appointed to the United States Naval Academy from the Territory of Oregon, and reporting there he took a high place amongst the studious and earnest men of his class.

The outbreak of the Civil War took all of his class to sea and Lamson soon was able to demonstrate his qualifications as an officer. On May 9, 1861, the commandant of midshipmen, Lieutenant-Commander C. R. P. Rodgers, on orders from the Department, sent Lamson, then a second classman, as an acting master to the frigate *Wabash*, the flagship of Admiral Dupont. On November 11, 1861, flag officer Dupont, in his report of the capture of Fort Walker and the defenses of Hilton Head, gave to young Lamson special praise for his work with the pivot guns of the vessel in action, saying that he had "sustained the reputation of the Naval Academy" and was a valuable officer, and subsequently he was commended for efficient work in an armed launch protecting the bridge across the Savannah river.

On August 1, 1862, Lamson was promoted to be a lieutenant and then was given a brief term of duty in the Navy Department, where he evidently soon became a favorite with his superiors.

In 1863, when an important movement of the North Atlantic Blockading Squadron was being prepared for, Lieutenant Lamson was sent to the U. S. S. *Minnesota*, flagship of Admiral S. P. Lee. Assistant Secretary G. V. Fox wrote to the admiral as follows:

> Your second lieutenant is to be detached and we send you young Lamson in his place. Lamson was expected to go on other duty, but in anticipation of your movement upon the enemy, I thought you might wish upon your staff, at least for this fight, a young man that Dupont and Rodgers consider one of the very best in the service. Davis has had him in the bureau for a month and speaks in the highest terms of him. I feel that you ought to have him for this occasion since you have no flag lieutenant.

It was just at this time that I met him, I having just been ordered as confidential aid to the admiral, and Lamson accorded me the conveniences of his stateroom, as all the other staterooms were occupied by my seniors. I soon became devotedly attached to him. From daily and intimate association with him I soon came to appreciate how high-minded and noble-hearted he was. His personal character was of the most lovable kind, pure-minded, highly strung, full of professional zeal and loyal to the core, he was ever seeking to win the confidence of his superiors, the regard of his fellow officers and the affection of the men of the crew. He was amiable, affable, and scholarly, as all who met him soon discovered, and his friendships multiplied steadily.

Lamson's courage was of the noblest kind. He was not rashly daring or reckless in his enterprises. When there was grave

danger in any duty assigned to him, he not only fully prepared himself for its performance, but for its possible consequences to himself. He never quailed in the presence of danger.

As I have mentioned, he was deeply religious, and in my association with him I learned the more tender and loving impulses of his heart.

I noted that, whenever he had any serious undertakings before him, he always withdrew for an hour or two to the quiet of his stateroom, from which he always came calm, resolute and ready for the work before him.

Accident one day revealed to me the secret workings of his heart and mind in those moments of seclusion. So intimate had I become with him that I had never hesitated to rush in upon him when alone. It was just after he had received his orders to go up the Nansemond river, to confront the Confederate forces on its banks, that I thus thoughtlessly started to enter his stateroom. There was my friend Lamson with the photographs of his father and mother and of his sweetheart on his desk before him, and he held his Bible open in his hands. So absorbed was he that I quietly withdrew without disturbing him.

My respect and regard for him was deepened as I thus came closer to his soul. He knew that in the work before him every hour was fraught with the danger of instant death from the bullets of the sharpshooters of the enemy. Whilst thus communing for those brief moments, he had in spirit taken his parents and his loved one to his heart. He had made his peace with his God. Then, having satisfied the sentimental side of his being, he came out on deck calm and cheerful, the ready, alert, and active officer, and devoted himself to his task, the God of battles whom he had invoked watching over and protecting him throughout the dangers he so quickly met.

The admiral was constantly calling upon him for his opinions and became his great admirer, often assigning him to most responsible duties.

Early that year the Confederates were particularly active in southeastern Virginia. A large force, under Generals French, Longstreet and Hood, had been sent down from the army defending Richmond, and advancing eastward threatened to surround the Federal forces under Generals Keyes, Peck and Getty, near Suffolk, upon which depended the protection of Norfolk. Major-

General Keyes, keenly alive to the situation, appealed to Admiral Lee for coöperation to protect his right flank along the Nansemond river north of Suffolk. The situation is shown on the accompanying sketch. Early in the month of April scouts reported that a force of over 10,000 men was approaching the left bank of the Nansemond. A row of piling had been placed across the river just below the Western Branch as an obstruction, leaving only a narrow opening for the passage of light-draught vessels in the mid-channel.

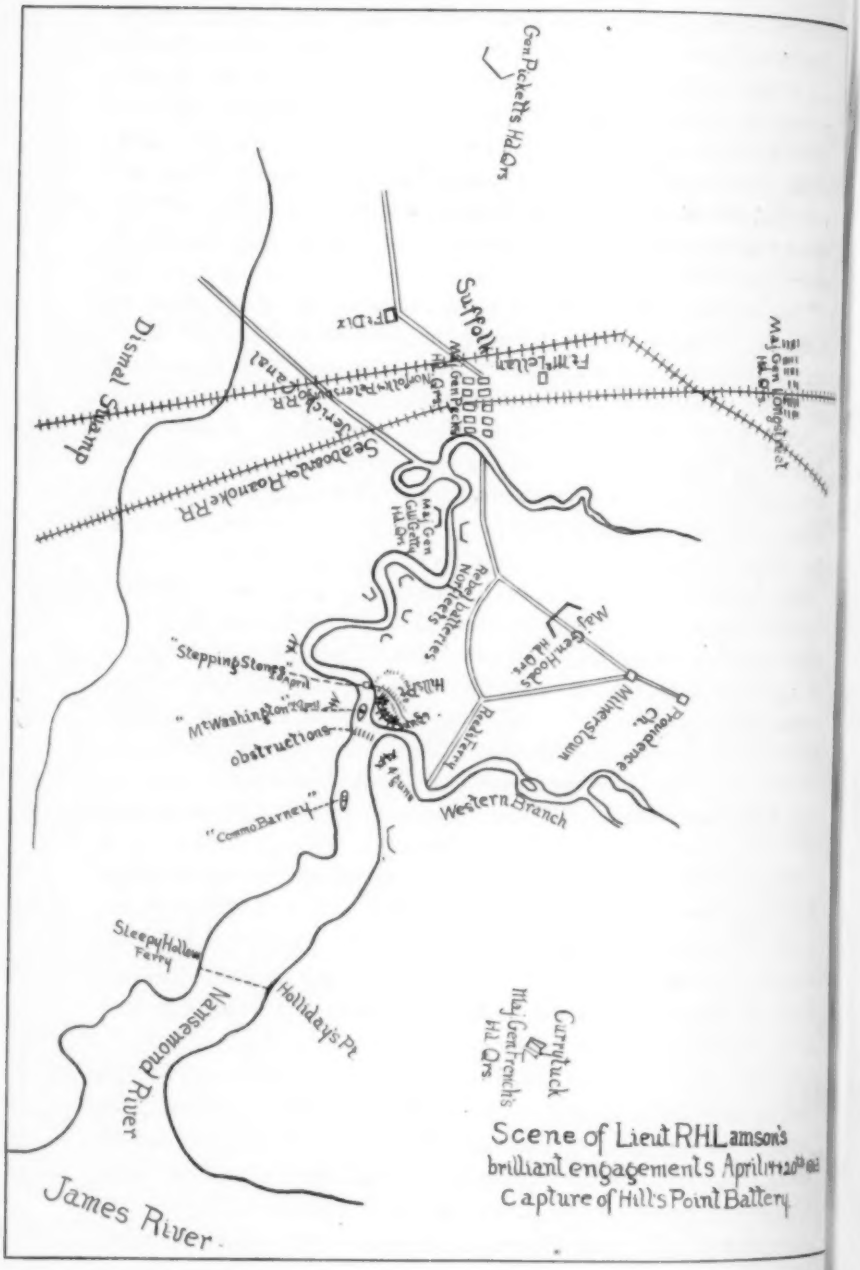
Their artillery had been put in batteries at different points to check any advance on the part of the Federal troops, and their sharpshooters were strong along the entire left bank to harrass the army and naval tug-boats passing up to Suffolk.

Just prior to this, Admiral Lee had planned an attack upon Jamestown Island by a small flotilla under command of Lieutenant William B. Cushing, but on receipt of the call from General Keyes he diverted this flotilla to the lower Nansemond to guard the stream from the Western Branch to the James river.

Flag Lieutenant Lamson was detailed to guard the tortuous stream above the Western Branch to Suffolk, his line of duty covering about seven miles of narrow channel within easy rifle-shot of the shore throughout its entire distance, whence the enemy, concealed in the woods, kept up a constant fire upon the pilots and helmsmen of the small flotilla under his command, which was composed of the small sidewheel steamer *Mount Washington* and the little ferry-boat *Stepping Stones* and two small tugs, all armed only with 12- and 24-pounder howitzers.

The pilot-houses and bulwarks were covered with sheets of boiler iron, which would only turn a leaden rifle bullet, but were practically no protection against field-guns of any caliber. Lamson, with his command, reached Suffolk on the 12th of April under a heavy fire from sharpshooters, and was soon in conference with the commanding general.

On the 13th he took Major-General Getty down stream to observe the situation and landed him below Western Branch. At dawn on the morning of the 14th, he proceeded up stream with his little vessels, and at a point below the bend near Norfleet's, a battery of seven guns opened on the *Mount Washington* and soon a shot pierced her boiler, disabling her entirely. She was taken in tow by the *Stepping Stones*, and they withdrew down stream,


Gen Pickett's Hd Qrs
Suffolk
Dismal Swamp
Seaboard & Roanoke RR
Norfolk & Petersburg RR
Norfolk & Petersburg Canal
Maj Gen Longstreet
Hd Qrs
Maj Gen Gilmore
Hd Qrs
Rebel batteries
Maj Gen Hooks
Hd Qrs
"Stepping Stones"
"Mt Washington"
obstructions
Hills Pt
Guns
Western Branch
Millerstown
Providence Ch.
"Como Barney"
Sleepy Hollow Ferry
Hollidays Pt
Nansemond River
James River
Currytuck
Maj Gen French's
Hd Qrs
Scene of Lieut R H Lamson's
brilliant engagements April 12th &
Capture of Hill's Point Battery

still under a heavy fire from the riflemen on shore. The tide was falling and soon the *Mount Washington* went aground on a shoal a short distance above the Western Branch obstructions, when a five-gun battery, on Hill's Point, just abreast of them, unmasked, and its storm of shot soon riddled and further disabled the vessel, killing and wounding a number. Lamson saw the almost hopelessness of the situation and called the *Stepping Stones* alongside, transferred the killed and wounded, and then ordered all the officers and men of the *Mount Washington* to go aboard of that vessel, and sent her down stream to the protection of Cushing's command. He did not abandon his disabled steamer, however, but kept with him the boat's crew he had brought from the *Minnesota* with Master's Mate Birtwistle.

As soon as the *Stepping Stones* had cast off her lines and steamed down below the obstructions, Lamson with his men carried a small howitzer to the hurricane deck, and from between the paddle-boxes kept up as rapid and continuous a fire into the battery as he could whilst waiting for the rise of the tide to see what he could do to save the steamer. His men fought with wonderful daring, those not at the gun using their carbines to keep down the enemy in the earthworks. Thinking at last that he might be able to haul the vessel off, he directed his men to man the cutter to run a line to a pile that was on the enemy's side of the channel up stream. The crew at first hesitated to meet the hail of shot that tore across the deck, but Lamson stepped briskly out to the open deck at the bow, under the hail of bullets from the sharpshooters on shore, and told them to come forward to him, which they did with a rush, and, manning the boat, ran the line to the pile. Just as they secured a loop over it, a chance shot missed the boat, but cut the pile in two, and the line dropping into the stream, the boat returned to the steamer, where the men again worked their gun upon the enemy.

One of the seamen, Garcia, was cut in two by a shot, and as his body went overboard, his messmate, Sam Woods, dived over after it, but it sank at once, and swimming back he mounted the deck, and, all soaking as he was, coolly returned to his station at his gun.

All this time a continuous fire from the enemy's sharpshooters in the woods was being kept up upon the little band of heroes. Soon a shot carried away the flagstaff about two feet above the

deck and a shout of delight went up from the rebels when they saw the flag go overboard into the stream. Lamson, with Birtwistle and seaman Theilburg, heedless of the bullets that swept around them, ran aft, hauled up the flagstaff by its halliards, and placing its foot against the stump, Lamson ran the flag to the truck and then expended the halliards in securing the staff to the stump!

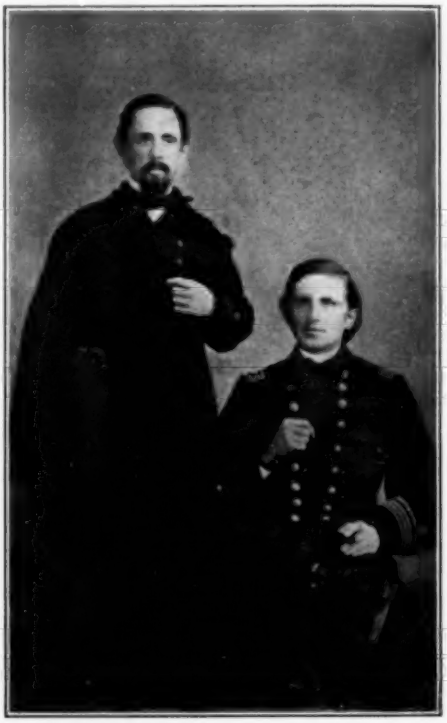
As soon as the wind filled out the Stars and Stripes in their glory, firing ceased at once from the shore; the rebels mounted their works and gave three rousing cheers to Lamson and his gallant men; and he was told that he could, without interruption, call up the *Stepping Stones* to tow his crippled steamer down the river. This was promptly done. What a tribute was not that to valor! What a chivalric spirit, was it not, that prompted it from the enemy!

During Lamson's engagement up stream, Lieutenant Cushing and his few vessels were kept busy returning the fire of the enemy, who, besides their guns on Hill's Point, had a four-gun battery in the woods north of the Western Branch, and a large force of riflemen in the bordering woods to harass his men. Cushing sent forward a brief report of the engagement, in which he extolled the brilliant work of Lamson, and sending with it the wrecked steamer as an exhibit, he said:

> It is only necessary to look at the *Mount Washington* to see with what desperate gallantry Lieutenant Lamson fought his vessel.

But Lamson had been placed in command of the Upper Nansemond, with instructions to prevent the enemy from crossing that stream to attack the flank of the Federal forces. He did not bother about writing any long-winded reports to the admiral. He had no thought of self-glorification, nor did he return to his comfortable stateroom on the *Minnesota* to entertain his messmates and the reporters with lurid tales of his recent experiences. That was not *his* nature!

As soon as darkness permitted, that same evening, he went on board of the *Stepping Stones*, and, accompanied by the tug *Alert*, slipped quietly through the obstructions, whilst the enemy, possibly absorbed in celebrating their victory, were forgetful of the duty of vigilance, and he soon reached Suffolk in safety and reported to the commanding general that he was at hand for action. He wrote a brief note to the admiral announcing his being at Suf-



LT. ROSWELL H. LAMSON LT. WM. B. CUSHING

WASHINGTON, 1863

folk, and stated therein, " I shall not be satisfied unless I can take that battery that knocked the *Mount Washington* to pieces."

His ingenious mind soon formulated a plan of action which he submitted to General Getty, the nearest general officer he could confer with. He took his maps with him and explained his plans in detail, urging their adoption with all the energy of his soul. His enthusiasm won over General Getty, who promised him all he asked in coöperation. A day or two was lost awaiting the approval of the plan by Admiral Lee, who, being devoted to his flag lieutenant, was at first loth to permit him to run the great risk, and sent the fleet captain, Pierce Crosby, to Suffolk with orders to Lamson to withdraw his flotilla unless his good judgment suggested otherwise. The fleet captain, also, was won over by Lamson, who was left to his own absolute judgment in the matter!

Promptly Lamson directed that hammock cloths should be strung all around the vessel from the awning ridge ropes to hide the decks of the *Stepping Stones.* He had four field howitzers ready with their crews thoroughly drilled in what they were to do, and long gang-planks were prepared, down which the guns were to be run at the word. General Getty detailed 300 men from the 89th New York Volunteers, under Lieutenant-Colonel England, and from the 8th Connecticut Volunteers, under Colonel Ward, and went with them himself to see that his officers and men should carry out exactly and implicitly the orders of Lieutenant Lamson.

Down stream went the *Stepping Stones,* as soon as all were on board, on April 20, moving slowly until just above the heavy battery on Hill's Point which had crippled the *Mount Washington.* The lookout reported that the enemy had all of their guns trained upon one part of the channel where they were sure that their concentrated fire would blow the vessel out of water. Lamson, pretending that he was afraid to venture into that zone of fire, stopped the vessel and slowly retired up stream, where he rested for a while. Then, as though intending to make a supreme dash past the battery, he ordered full speed ahead, and down stream went the *Stepping Stones* until just short of the bend above the battery, when the helm was put to starboard and she went hard against the river-bank. Up were triced the hammock cloths, out was rushed the gang-plank, down which the ready crew ran their howitzers, and up to the crest of the ravine back of the battery.

The soldiers, under General Getty, were rushed through the

To Suffolk
mid Channel
U.S. Stepping Stones
April 20th '63
Howitzers to rear of battery
Route of U.S. Yale in ravine
HILL'S POINT
Battery
WESTERN BRANCH
Line of piles obstructing Ri
Rebel battery
(in Woods
Rebel battery
A Rebel gun trained
on this point
"Mt Washington"
riddled w shore
April 14th — 1863
"Mt Washington"
Landing
S
E
M
N
Lt Cushing's
command
"Cohasset"
"Commodore Barney"
NANSEMOND RIVER
LAMSON'S VICTORY
on the Nansemond
April 20th '63

ravine out of sight until they had a position to cut off all retreat. The amazed rebels in the battery stood inactive for a moment and then attempted to swing a gun around to their rear. At their first shot, which passed over the heads of our men, a volley of cannister was fired into the battery, and its commander surrendered at once. By sunset the five guns of this battery and all the ammunition, together with the entire force of the enemy there, 161 men (not a man escaping), were transferred to our side of the river under guard, the captain commanding having surrendered his sword in person to Lieutenant Lamson, who had thus nobly recouped for the drubbing they had given him six days before.

General Getty assumed charge on shore and Lieutenant Lamson soon after returned to the flagship and was fairly "laurel-crowned" with congratulations showered upon him by General Getty, by his comrade Cushing and by his admiral, all of which was followed quickly by eulogy in glowing terms from the Secretary of the Navy. Amongst the commendations of Lamson's gallantry in this engagement we find Admiral Lee writing to Secretary Welles as follows:

> Flag Lieutenant Lamson deserves the fullest credit for the success of the expedition which captured the West Branch battery so handsomely, taking 5 pieces and 161 men.

Major-General George W. Getty wrote to Admiral Lee, April 20, 1863:

> I desire to express most sincere thanks to Captain Lamson, U. S. Navy, his officers and men for the gallantry, energy and ability displayed by them in the operations of yesterday, resulting in the capture of one of the enemy's batteries of five guns.

Major-General Peck wrote to Admiral Lee, April 21:

> The Navy has many gallant spirits, but none more so than Lieutenants Lamson, Cushing and Harris.

Major-General Dix wrote to Admiral Lee, May 2, 1863, stating that the admiral's letter, authorizing Lieutenants Lamson and Cushing to coöperate with the army on the Nansemond river,

> . . . . is all I can ask, and I know that the spirit and gallantry those young officers have exhibited on all occasions will insure us all the aid it is possible to afford.

Secretary Welles, on April 24, wrote to Admiral Lee:

> Great credit is due to Lieutenants Cushing and Lamson for the courage, skill and energy displayed by them in an emergency requiring the exercise of undaunted bravery and resolution.

Admiral Lee wrote to Lieutenant Lamson on April 29 a letter full of commendation for his courage, skill and energy, expressing approval of his gallant conduct, and on May 4, 1863, the Secretary of the Navy wrote to Lamson expressing admiration for his important and meritorious service, his discretion and valor, and stating that

> The Department congratulates you on your success and is proud to see in the younger members of the corps such evidence of energy, and gallantry and executive abiiity, scarcely surpassed by those of more age and experience.

These successes on the Nansemond effectually ended the advance movements of the enemy against Norfolk.

In May, with a view to giving Lamson some experience of blockade life, he was ordered to command the *Nansemond*, a speedy little craft named after the victory on the Nansemond, and mounting a light Parrot rifle and a few howitzers. Before he could get away to sea, however, the rebels became exceedingly active in planting torpedoes in the James river near Chapin's Bluff, and to destroy their work the admiral selected Lamson as the one best suited for effective work in that line, and on May 12, 1863, ordered him to command a small flotilla composed of the *Stepping Stones, Delaware* and *Tritonia,* with general instructions to clear the river of the torpedoes.

Without a day's delay Lamson steamed up river and, under the fire of the rebel batteries and sharpshooters, began to drag the river above Trent's Reach and near Chapin's Bluff in mid stream and close to the banks. Within fourteen days he returned to the flagship reporting that he had discovered fifteen torpedoes, some containing as much as 2000 pounds of powder, had cut the wires connecting with the galvanic batteries on shore, and had hauled up the torpedoes and brought them away with him. He was then, on June 27, charged with the blocking of the river at Trent's Reach, which he did by sinking five schooners to prevent rebel rams from descending the river.

On July 4, 1863, the Confederate Commissioners, Alexander H. Stephens, Lieutenant-Commander Hunter Davidson and Robert Ould, came down the James river and sought permission to go to Washington in the Confederate boat *Torpedo*. Flag Lieutenant Lamson was detailed to stop that vessel until orders were received from Washington in regard to the request made. Lamson boarded

the *Torpedo* and carried out his orders with firmness and tact. The request for leave to go to Washington was refused and Lamson saw that the *Torpedo* returned up river under her flag of truce.

Rejoining his little *Nansemond*, we next find him actively engaged on the coast above Cape Fear river, having reported for duty to Divisional-Commander Benjamin F. Sands, and the records are full of reports of his work—chasing, running ashore or capturing blockade runners, destroying the *Douro* and the *Venus* and capturing the *Margaret and Bessie*.

On December 14, 1863, the little *Nansemond* was caught off the coast in a terrific gale and nearly foundered. Lamson was compelled to throw his guns overboard, and by so doing he saved his vessel and brought her safe to port, and he was commended by the admiral for his efficient conduct and skill on that occasion.

The captured blockade runner *Margaret and Bessie* had been purchased by the government and fitted out for blockade service, being renamed the *Gettysburg*. Lieutenant Lamson was ordered to command her and the writer was, at his request, also attached to her on February 14, 1864. The admiral and the divisional-commander gave him full discretion as to where he would cruise to be of the best use in sustaining the blockade, and he carefully studied the routes over which the blockade runners were accustomed to go in their efforts to evade the blockading fleet. He again proved his efficiency, skill and professional knowledge.

After one two-weeks trip in which he had tested the speed and seagoing qualities of his new command, he had the vessel docked at the Norfolk Navy Yard. When the steel bottom of the vessel had been thoroughly scraped, cleaned and painted, Lamson bought a barrel of tallow and had it melted down and applied hot to the whole bottom before leaving dock. Steaming away to the blockade, a blockade runner was sighted off Cape Lookout, and the *Gettysburg* established a record for speed. The runner, which proved to be the *Lillian*, with 619 bales of cotton on board, was soon overhauled, captured and sent into port.

Then came the attacks on Fort Fisher. Lamson was selected again for the hazardous duty of seeing to the safety of Captain Rhind and his officers and crew, when the giant torpedo, "The Louisiana" was exploded under the guns of the fort. He discharged the duty with skill and safety.

During the bombardments of December 24 and 25, 1864, the

little *Gettysburg* was shoved into the front line of the fleet, and, from between the larger vessels, her little 30-pounder Parrot rifle kept up a continuous fire on the Mound Battery. When the fleet returned on January 14 to attack that great fort, Lamson learned from the admiral of the proposed landing of the sailors to participate in the assault. He obtained permission to join the party and landed on the morning of the 15th of January, 1865, with three of his officers and 72 men.

In the assault the *Gettysburg* party was well up to the front and Lamson fell, wounded severely, close to the Palisades, where he was compelled to remain, disabled, until nightfall permitted his being brought off and taken to the *Gettysburg*, whence he was afterwards sent north for hospital treatment. His gallantry in that action was warmly commended by Admiral Porter in his report of the victory.

Upon his recovery, Lamson was appointed flag lieutenant to Admiral L. M. Goldsborough, and reported for duty on the flagship *Colorado*, and served for some time on that duty in the Mediterranean Squadron.

Finding that no further recognition was to be given for his brilliant services and that promotion would only come to him when his seniors died off in order to make vacancies in the higher grades, he became discouraged and resigned in 1867.

He went into business in the Windsor Manufacturing Company of Windsor, Vermont, and on November 14, 1867, married Miss Catherine Buckingham, the daughter of General C. P. Buckingham, then Governor of Connecticut. The company became a failure and he lost everything, and then returned to Oregon, in 1870.

In 1874 he was elected county clerk of Yamhill county for two years, and in 1876 was appointed a Professor of Mathematics at the Pacific University at Forrest Grove. In 1877 he was appointed clerk of the United States Circuit and District Courts. Whilst so serving he began to suffer from locomotor ataxia, the outcome of his exposure in the naval service, and in 1894 he resigned.

In 1895 he was reappointed a lieutenant in the navy in recognition of his admirable war services, and was put on the retired list.

He died on August 14, 1903, leaving two children surviving him, a son Roswell B. Lamson, an attorney-at-law in Portland, Oregon, and a daughter, Helen, now Mrs. Clarence S. Crary, of Mayfield, California.

An interesting incident connected with Lamson's restoration to the naval list may be cited as showing an estimate of great men of his valor and valuable services.

At one of the monthly reunions of the District of Columbia Commandery of the Loyal Legion in 189-, the writer, to entertain the large audience of Civil War veterans who were present, read a paper relating to life on the blockade, and gave a description of Lamson's victory on the Nansemond. It was received with enthusiastic applause and a gray-bearded officer came forward and, announcing that he was Major-General George W. Getty, who had coöperated with Lamson in that affair, declared that the narrative was absolutely accurate in every detail and spoke in the warmest eulogy of the young officer.

Then Major-Generals Redfield Proctor, John G. Hawley and Charles W. Manderson, all United States Senators, asked the writer where Lamson was and what he was doing. They were told that he was a great sufferer from locomotor ataxia. "Why do you not do something for him?" they asked. "We always look after our disabled veterans in the army and see that they are well provided for by the government, when they have such records."

"But the naval veterans are not found in Congress," was the writer's reply, "so what can I do?"

"Act in some way," they said, "and we pledge ourselves to aid you in Congress, because his brilliant achievements deserve such recognition."

I thanked them and, remembering that a special act had been passed in the early eighties for Lamson's restoration, which he had then declined to avail himself of, as it would have broken up his home, I wrote to Lamson, and within three weeks a petition came on, signed by the Bench and Bar of Oregon, asking for his restoration to the service. I had it promptly presented to President Cleveland and the bureau chiefs in the Department endorsed it strongly.

The President sent the nomination in promptly but without giving any reasons for the action.

The clerk of the Naval Committee, knowing of my associations with naval officers, sent for me and asked if I knew anything about Lamson. I told him I did, and wrote out a brief sketch of his heroism in battle. He took the paper up to the Senate floor and in five minutes down came Senator Eugene Hale, with the paper in his hand.

"Is this the young officer," he exclaimed, "of whom Manderson, Hawley and Proctor have been talking to me, whose story you told to the Loyal Legion some time ago?" I assured him it was and he left the committee room, asking me to wait a while. Inside of twenty minutes he returned and informed me that he had broken in upon the business of the Senate with a motion to go into executive session, and had the nomination unanimously confirmed.

Such prompt recognition of Lamson's merit from such great men, and from officers of such distinction, was a beautiful tribute to the merit of my friend and comrade, and I have always felt grateful to them for that action.

Had Lamson not resigned in 1867, he would doubtless have left a longer record of usefulness to his country, his professional attainments being of the highest order and his devotion to duty being always perfect and admirable.

Therefore it is that we must recognize the fact that the navy is honored by thus having one of the newest type of torpedo-boat destroyers named the *Lamson*, in evidence that his grateful country remembers his distinguished and meritorious services in the Civil War, and points to his admirable record as one to be emulated by all who enter the naval service.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

TORPEDO FIRE AT MOVING TARGETS.*

THE EFFECT OF ERRORS IN ESTIMATING THE SPEED AND COURSE OF THE TARGET.

By M. CHAPUIS.

Translated by PHILIP R. ALGER.

Generalities.—When a torpedo is fired from a moving vessel, it is observed that the torpedo ceases almost immediately to retain the proper motion of the vessel from which it was launched, the resistance of the water very rapidly destroying the movement of translation which is not mechanically sustained: there is, therefore, no sensible difference between the case where the torpedo is launched from a vessel at rest and that where it is launched from a vessel in motion. In all that follows it will therefore be unnecessary to take account of the speed of the vessel that fires the torpedo.

On the other hand, the torpedo under the action of its motor very quickly attains its standard speed; we shall therefore assume that the speed of the torpedo is constant throughout its course.

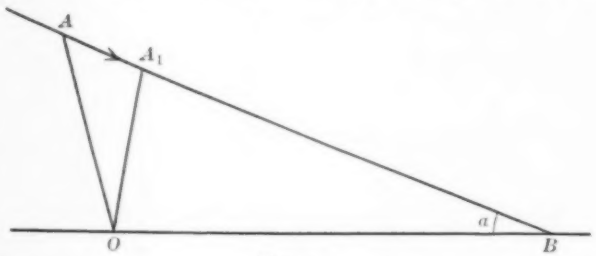


FIG. 1.

On these hypotheses it is easily seen how a torpedo ought to be fired to hit a vessel in motion; let A (Fig. 1) be the point to be hit, having a velocity v in the direction AB which makes an angle a with the course of the torpedo vessel O.

*From the Bulletin de L'Association Technique Maritime, No. 19. Session of 1908.

Let us suppose that O and A represent the respective positions of the assailant and the target at the moment of firing.

To strike the moving target A, the torpedo must be fired in a direction OA_1 such that

$$\frac{AA_1}{v} = \frac{OA_1}{V},$$

V being the speed of the torpedo.

To determine the direction OA_1 a sighting apparatus is furnished which enables the sighter to construct a triangle similar to OAA_1: to construct this sighting triangle it is necessary to know:

(1) The speed of the torpedo V.

(2) The speed of the target v.

(3) The course of the target relative to that of the assailant, and consequently, the angle $\alpha = ABO$.

The assailant can know with great accuracy the speed V of the torpedo that he fires; I will suppose, at least for the moment, that no error is made in the estimation of this speed V of the torpedo.

As for the speed v of the target and the course of that target (a course characterized by the angle α), the assailant can only estimate them; this estimate being subject to errors, we are going to seek to evaluate the influence of these errors upon the value of the error at the target.*

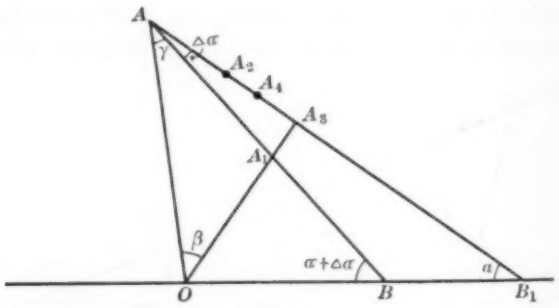


FIG. 2.

Let us suppose that the observer situated at O estimates at $v+\Delta v$ and $\alpha+\Delta\alpha$ the speed and course of the target, while their exact values are v and α.

In other words, the observer estimates that the target is moving

* By the "error at the target" the author means the distance ahead or astern of the target at which the torpedo crosses the path of the target.—P. R. A.

with the velocity $v+\Delta v$ in the direction AB (Fig. 2), while the target is really moving with the velocity v in the direction AB_1; the sighting triangle is constructed according to the observers' estimates and the torpedo is fired in the direction OA_1.

When the torpedo, at the end of a certain time T, reaches A_1 (the intersection of the direction of fire and the supposed course of the target), it does not meet the point aimed at which at the same instant reaches A_2, in the line AB_1, the distance AA_2 being equal to vT.

The torpedo continues its course and after a total time $T+\Delta T$ meets the *real* course of the target at A_3, A_1A_3 equalling $V\Delta T$. When the torpedo reaches A_3 the target is at A_4 in the line AB_1, A_2A_4 being equal to $v\Delta T$.

The error at the target is therefore A_3A_4. Let us seek to determine this error.

Calculation of the Error at the Target in the General Case.—The conditions of sighting give

$$OA_1=VT,$$
$$AA_1=(v+\Delta v)T.$$

Moreover, we have

$$A_1A_3=V\Delta T,$$
$$A\,A_4=v(T+\Delta T).$$

If we call E the error at the target A_3A_4, we have

$$E=A_3A_4=AA_3-AA_4=AA_3-v(T+\Delta T).$$

In the triangle AOA_1, we have

$$\frac{OA_1}{\sin\gamma}=\frac{AA_1}{\sin\beta}=\frac{OA}{\sin(\beta+\gamma)},$$

or

$$\frac{VT}{\sin\gamma}=\frac{(v+\Delta v)\,T}{\sin\beta}=\frac{OA}{\sin(\beta+\gamma)}. \qquad (1)$$

In the triangle AOA_3, we have similarly

$$\frac{V(T+\Delta T)}{\sin(\gamma+\Delta\alpha)}=\frac{OA}{\sin(\beta+\gamma+\Delta\alpha)}. \qquad (2)$$

Combining equations (1) and (2) we have

$$V\Delta T=OA\left[\frac{\sin(\gamma+\Delta\alpha)}{\sin(\beta+\gamma+\Delta\alpha)}-\frac{\sin\gamma}{\sin(\beta+\gamma)}\right]. \qquad (3)$$

This formula (3) enables us to calculate ΔT *exactly* from the given data in any case.

Similarly, we have

$$\frac{AA_3}{\sin\beta} = \frac{OA}{\sin(\beta+\gamma+\Delta\alpha)} = \frac{V(T+\Delta T)}{\sin(\gamma+\Delta\alpha)}. \qquad (4)$$

Which enables us to calculate *exactly* AA_3.

Therefore in each case we can determine the exact value of the error at the target for errors Δv and $\Delta\alpha$ of any value whatever.

Calculation of the Error at the Target in the Case of Small Errors.—Let us now suppose that Δv and $\Delta\alpha$ are very small, so that we may neglect in our calculations the values

$$(\Delta v)^2,\ (\Delta\alpha)^2,\ \Delta v\Delta\alpha, \text{ etc.}$$

The formulæ will be greatly simplified.

From formula (3) we deduce, after reductions,

$$V\Delta T = \frac{vT}{\sin(\beta+\gamma)} + \Delta\alpha.^* \qquad (5)$$

So too formula (4) gives after reductions

$$AA_3 = (v+\Delta v)T - \frac{vT\cos(\beta+\gamma)}{\sin(\beta+\gamma)^\dagger}\Delta\alpha \qquad (6)$$

Putting these values in the formula for the error at the target, we obtain

$$\ddagger\ E = T\Delta v - vT\left[\frac{\cos(\beta+\gamma)}{\sin(\beta+\gamma)} + \frac{v}{V}\frac{1}{\sin(\beta+\gamma)}\right]\Delta\alpha$$

In the coefficient of $\Delta\alpha$, $\frac{v}{V}$ may be replaced by its approximate value $\frac{v+\Delta v}{V} = \frac{\sin\beta}{\sin\gamma}$. The coefficient in parentheses

$$\frac{\cos(\beta+\gamma)}{\sin(\beta+\gamma)} + \frac{\sin\beta}{\sin\gamma}\frac{1}{\sin(\beta+\gamma)}$$

can be simplified.

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* So stated but really should be $\frac{vT\Delta\alpha}{\sin(\beta+\gamma+\Delta\alpha)}$.—P. R. A.

† Should be $\sin(\beta+\gamma+\Delta\alpha)$.—P. R. A.

‡ Sin $(\beta+\gamma+\Delta\alpha)$ has here been given its approximate value sin $(\beta+\gamma)$. P. R. A.

Letting $\frac{\sin\beta}{\sin\gamma}=m$, we have

$$\frac{\cos(\beta+\gamma)}{\sin(\beta+\gamma)}+\frac{\sin\beta}{\sin\gamma}\cdot\frac{1}{\sin(\beta+\gamma)}=\frac{\sqrt{1-m^2\sin^2\gamma}\cdot\cos\gamma-m\sin^2\gamma+m}{m\sin\gamma\cos\gamma+\sin\gamma\sqrt{1-m^2\sin^2\gamma}}$$

or, reducing,

$$\frac{\cos\gamma}{\sin\gamma}\left[\frac{\sqrt{1-m^2\sin^2\gamma}+m\cos\gamma}{m\cos\gamma+\sqrt{1-m^2\sin^2\gamma}}\right]=\cot\gamma.$$

Finally, we have for the value of the error at the target E, in the case of small errors,

$$E=T\Delta v-vT\cot\gamma.\Delta a.$$

Another Method of Calculation in the Case of Small Errors.—In the case of small errors, we can obtain the error at the target by assuming that the errors due to each of the errors Δv and Δa are independent of one another. Consequently we have only to calculate: (1) the error due to an error Δv when Δa is zero; (2) the error due to an error Δa when Δv is zero. The total error will be the algebraic sum of the two partial errors thus determined.

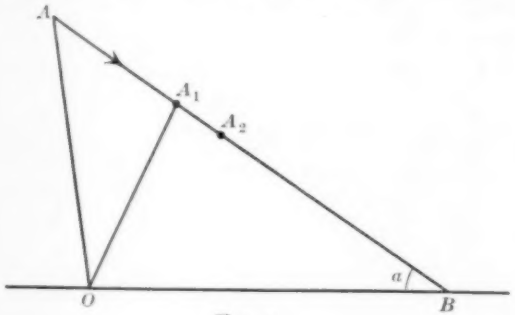

FIG. 3.

Calculation of the Partial Error Corresponding to an Error Δv in the Speed of the Target.—Let us suppose that the operator makes a mistake only in the speed of the target, which he estimates at $v+\Delta v$ when it really is v. In this case, when the torpedo reaches A_1 (Fig. 3), the target will be at A_2. The error will therefore be A_1A_2. But we have

$$AA_1=(v+\Delta v)T,$$
$$AA_2=vT.$$

The error A_1A_2 will be the difference between the distance AA_1 and AA_2; its exact value will therefore be $T\Delta v$.

Calculation of the Partial Error Corresponding to an Error $\Delta\alpha$ in the Course of the Target.—In the case where the operator is mistaken only in his estimation of the course of the target, we find ourselves under the conditions of Fig. 4. When the torpedo is at A_1, the target is on AB_1 at a distance from A equal to vT. During the time ΔT which the torpedo takes to traverse A_1A_2, the target travels a distance which is represented (within the limit of an infinitesimal of the second order) by aA_2, a being the point of intersection of AB_1 with a parallel to OA through A_1.

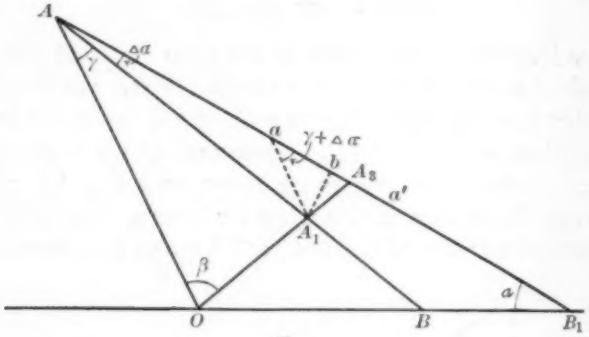

FIG. 4.

In fact, the angle $\Delta\alpha$ being supposed very small, the two triangles OAA_1 and A_1aA_2 may be regarded as similar, whence we have

$$\frac{aA_2}{AA_1}=\frac{A_1A_2}{OA_1}=\frac{V\Delta T}{VT},$$

and, as $AA_1=vT$, this reduces to

$$aA_2=v\Delta T.$$

Therefore aA_2 represents, with the approximation indicated, the path traversed by the target during the time ΔT.

If a perpendicular A_1b is dropped upon AB_1, we have very nearly $Ab=vT$.

Therefore the point b represents the place where the target is when the torpedo is at A_1. When the torpedo is at A_2, the target will be at a', where $ba'=A_2a=v\Delta T$.

The error at the target will therefore be

$$A_2a'=ba'-bA_2=aA_2-bA_2=ab.$$

The length ab therefore represents the partial error at the target; but, in the right angled triangle aA_1b, we have

$$ab = A_1b \cot A_1ab,$$

and, with the accepted approximation,

$$A_1b = AA_1 \sin \Delta a = vT\Delta a,$$

moreover

$$A_1ab = \gamma + \Delta a,$$

$$ab = vT\Delta a \cot (\gamma + \Delta a) = vT\Delta a \cot \gamma.$$

The partial error at the target is therefore $vT \cot \gamma . \Delta a$, and combining the two partial errors, respectively due to Δv and Δa, we arrive at the formula already deduced

$$E = T\Delta v - vT \cot \gamma . \Delta a.$$

Consequence of the Formula for the Error at the Target.—From the preceding formula, an important consequence may be directly deduced:

The error at the target resulting from a misestimation of the speed of the target can never be annulled, but by a proper selection of the moment of firing the influence of an error in estimating the course of the target can be nullified.

In fact, the coefficient of Δv is T, the duration of travel of the torpedo, and this duration does not vanish in any practical case. But the coefficient of the error Δa in the course of the target contains the term cot γ which vanishes for $\gamma = 90°$. Therefore *a mistake in estimating the course of the target has no effect if the torpedo is launched at the exact moment when the target is situated at the foot of a perpendicular let fall from the point of launching upon the supposed course of the target.*

If this rule is not followed, the effect of an error in the course is added to that of an error in the speed of the target (the two effects may be added or one may be subtracted from the other according to the relative senses of the errors Δa and Δv, but on account of the independence of these errors it would be quite illogical to count upon one effect annulling the other).

Another consequence of the formula is that ships with fixed torpedo-tubes are obliged, in order to attack under the best possible conditions, to follow a certain determined course dependent upon the course of the adversary and his speed.

In fact, if ϕ (Fig. 5) is the fixed angle of train of the tube with relation to the center line of the ship O, we have, when $\gamma=90°$,

$$\beta+\phi+\alpha=90°,$$

and as

$$\frac{v}{\sin\beta}=V,$$

we deduce

$$\cos(\phi+\alpha)=\frac{v}{V},$$

and, ϕ, v and V being given, α must have a value satisfying this equation.

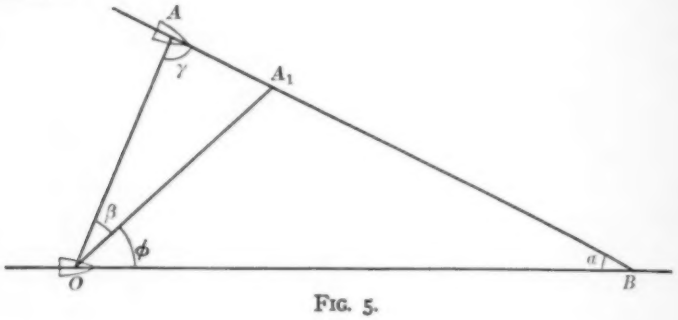

FIG. 5.

The course which the attacking vessel ought to follow is therefore perfectly determined, if it be desired to operate under the most favorable conditions.

Graphic Construction.—Upon a straight line AB representing the supposed path of the target, erect at A the perpendicular $A0$.

From A lay off on AB a distance AA_1 representing the speed of the target to any desired scale, $AA_1=Kv$. From A_1 as center describe an arc with radius $A_1O=KV$. From the point O thus found, draw in the proper direction (to the right if a port tube is to attack, to the left if a starboard tube) a straight line OB making with OA_1 the angle of train ϕ of the tube; the course of the attacking vessel should be OB (in the case of a bow tube, the course should be OA_1).

When the tube has a fixed position, the angle ϕ is known in advance and a table can be drawn up giving for different values of v and V the corresponding values of α calculated by the formula

$$\cos(\phi+\alpha)=\frac{v}{V}.$$

Let us observe in passing that this formula indicates the impossibility of attacking *with favorable conditions* a vessel faster than the torpedo; this remark, however, has no great importance, the case to which it refers being non-existent, at least for the present.

In the case of a tube having movement in train, ϕ may have several values, to each of which correspond two values of a, v and V being given.

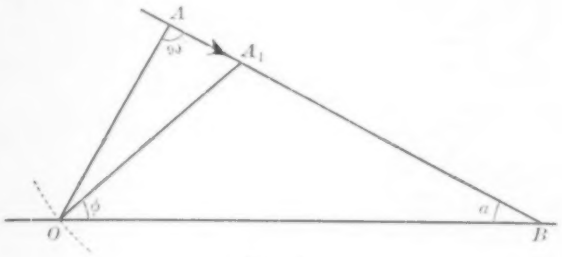

FIG. 6.

The equation, indeed, may be written

$$\cos\ (\phi+a)=\cos\ \omega_0,$$

putting

$$\cos\ \omega_0=\frac{v}{V}.$$

And so there are two solutions a and a' from

$$\phi+a\ =\omega_0,$$
$$\phi+a'=2\pi-\omega_0.$$

This formula could be equally well used to draw up tables giving the two values a and a' corresponding to the different possible values of ϕ, v and V.

To sum up, the employment of the method of firing intended to eliminate the error due to misestimation of the course of the target requires the assailant:

(1) In the case of a fixed tube, to follow an obligatory course.

(2) In the case of a movable tube, to select his course according to the train of the tube (or reciprocally).

We do not deny that this condition of a course to follow might be a serious embarrassment to the assailant. Would the indicated method be practicable? It is neither our affair, nor have we the

competence to answer. All that we have wished to show is, that it is possible by a suitable method of firing to eliminate the influence of the error of estimation of the course of the target. This being the case, it is important now to investigate the influence of the error whose effects cannot be corrected—the error in estimating the speed of the target.

We shall see later on what the effect of the other error is, in case it has not been eliminated.

The Influence of the Error in Estimating the Speed of the Target.—The formula which gives the error at the target

$$E = T\Delta v - vT \cot \gamma . \Delta a$$

contains a first term $E_1 = T\Delta v$ to which the error reduces when the torpedo is fired under good conditions.

This formula shows first of all that it is not the velocity of the torpedo that determines the value of the error, but rather the *duration* of the run: * under these conditions the influence of any given increase of speed of the torpedo is of so much the less importance as the torpedo is fast. If the speed V increases by a small quantity ΔV, the time taken by the torpedo to cover a given distance will decrease by a quantity proportional to $\frac{\Delta V}{V^2}$; this diminution of the time of travel for a given increase of speed ΔV will, therefore, be less sensible the greater V is. Beyond a certain speed the sacrifice which must be made to make the torpedo faster will only be recompensed by a very slight decrease of the error at the target corresponding to a given error in the estimation of the speed of the target.

In order to make clear the influence of this error, we have drawn up the following table which gives, for different values of the speed of the torpedo and of the distance it must run, the values of the errors at the target resulting from an error of 0.5 meters per second (about one knot) in the estimation of the speed of the target.

* This remark is general, and is true for all values, small or not, of errors made in estimating the speed and course of the target; this may easily be seen by examininig Fig 2: the error at the target A_2A_4 depends on the distance OA and is proportional to it, the velocities being given; consequently this error A_2A_4 is proportional, in all cases, to the duration of the torpedo's run.

I.—TABLE OF ERRORS FOR $\Delta v = 0.5$ M. S.

Speed of the Torpedo. Knots.	Distances run in meters.					
	400	*600*	*1000*	*1500*	*2000*	*3000*
20	19.5	29.0	48.5	73.0	97.5	146.0
25	15.5	23.5	39.0	58.5	78.0	117.0
30	13.0	19.5	32.5	48.5	65.0	97.5
35	11.0	16.5	28.0	41.5	55.5	83.5
40	9.75	14.5	24.5	36.5	48.5	73.0
45	8.75	13.5	21.5	32.5	43.0	65.0

The values of the errors at the target which exceed 10 meters are calculated to ±0.25 meters and those which are less than 10 meters to ±0.125 meters.

This table corresponds, as we have stated, to an error of about one knot in the speed of the target: we think that this approximation can be obtained by a practiced observer, but we do not believe that any greater precision can be counted upon in estimating the speed of the target.

If we wish to judge of the effects of an error in the target speed, we should note that the error will become inadmissible if it is greater than half the length of the target (the point aimed at being supposed to be the center of the ship attacked, and existing war ships against which the torpedo is used having lengths in the neighborhood of 100 meters, the maximum value of the admissible error will therefore be 50 meters).

Accepting this value of 50 meters, it will be seen that upon the hypothesis stated ($\Delta v = 0.5$ meters or 1 knot) firing at 1500 meters at a moving target could only be attempted with prospects of success with a torpedo having a speed close to 30 knots; firings at 2000 meters would require a torpedo running at about 40 knots; as for firings at 3000 meters, they would only be effective with a torpedo whose speed exceeded 50 knots (we are concerned, be it understood, with fire at a *moving* target).

With existing torpedoes the upper limit of range could therefore not exceed 1500 meters, even admitting that the firing was done under the best possible conditions.

Table I also shows the feeble influence upon the error at the target of an increase of speed; under the assumed conditions it may be seen, for example, that in firing at 1000 meters the error at the target is reduced from 32.5 meters to 21.5 meters when the speed of the torpedo increases from 30 to 45 knots, that is to say when the motive power of the torpedo is *trebled:* such a reduction is of no great importance in the case considered in view of the usual length of ships to be attacked.

Over small distances, 400 to 600 meters, the gains realized by increasing the speed of the torpedo from 30 to 45 knots are absolutely negligible; whence it results that for small vessels, such as torpedo boats and submarines, which must fire upon moving targets at short range, an increase of the speed of existing torpedoes would not appear to be necessary.

Fire at moving targets becoming ineffective beyond 1500 meters, the question of the torpedo's speed loses a good deal of its importance for long distances; at great ranges the employment of the torpedo would only be logical in the case of firing at a fixed target or in the case of firing at a group of vessels; in the first case the error at the target arises only from errors of pointing; in the second case it is not sought to strike any one vessel but a group of vessels forming a target of very great length having empty spaces and filled spaces; success in this special case is rather a matter of chance than of skill, and the probability of a hit may be represented by the ratio of the sum of the lengths of the filled spaces to the total length of the target.

Let us note in passing that in firings at a fixed target at long range the errors of pointing ought to be as far as possible eliminated. The maximum admissible error in firing at 3000 meters at a vessel of 100 meters' length is $\frac{50}{3000}$ or 57 minutes of arc; it is to be feared that existing means of pointing are not exact enough; and that, if long range firings at fixed targets are to enter into practice, there will be need of providing suitable apparatus (for example, for tubes that train, a sighting telescope fixed to the tube). It is still more evident that precautions of this sort would be necessary for firing at moving targets at great distances.

The Influence of the Error in Estimating the Course of the Target.—The second term of the formula giving the error at the target is, without regard to sign,

$$E_2 = vT \cot \gamma . \Delta\alpha.$$

All other things being equal, E_2 increases proportionally with increase of cot γ, and as might be expected, E_2 would increase beyond any limit if $\gamma = 0$ (target at an infinite distance).*

* This apparently absurb conclusion that in the case of the target apparently moving directly toward the assailant any error in estimating the course of the target would result in an infinite error at the target, arises from the author's assumption that the error at the target is the distance ahead or astern of the target at which the torpedo crosses the path of the target. In this case of $\gamma = o$, an error $\Delta\alpha$ would cause the torpedo's

Under the same conditions the error at the target for different values of γ would be represented by

0.177 if $\gamma=80°$,
0.364 " $\gamma=70°$,
0.578 " $\gamma=60°$,
0.839 " $\gamma=50°$,
1.192 " $\gamma=40°$,
1.733 " $\gamma=30°$,
2.750 " $\gamma=20°$,
5.681 " $\gamma=10°$.

It may be seen, therefore, that it is of enormous importance to approach to the condition $\gamma=90°$; and, to illustrate this, the error at the target corresponding to $\gamma=30°$ is, for the same error of estimation of the course of the target, about ten times as great as that corresponding to $\gamma=80°$.

In view of these figures we will admit that all precautions will be taken to make γ as near as possible to 90° and we will take 70° as the minimum value of γ (it is hardly necessary to point out that the errors are the same, except as regards sign, for $\gamma=\gamma_0$ and $\gamma=\pi-\gamma_0$).

Let us now note that the greater the speed of the target the greater will be the error at the target. We will assume in the following calculations that the maximum speed of the target is 20 knots.

The speed of the torpedo does not enter directly into the problem; the formula giving E_2 makes clear the absolutely general fact that it is the *duration* of the run which is of importance in the matter of the error at the target; in this respect we may repeat the observations before made with regard to the little influence of an increase of the speed of the torpedo beyond a certain value.

We have drawn up a second table giving under the same conditions as before the error at the target resulting from an error $\Delta\alpha$ in the course of the target; we have assumed that this course is estimated to within half a point, or about 6° (in circular measure, $\Delta\alpha=0.1$).

The assumed conditions of the table are therefore the following:

$v=20$ knots,
$\gamma=70°$,
$\Delta\alpha=0.1$.

course to be practically parallel to the target's course so that the two courses would only intersect at an infinite distance.—P. R. A.

II.—TABLE OF ERRORS FOR $v = 20$ KNOTS, $\gamma = 70°$, $\Delta\alpha = 0.1$.

Speed of the Torpedo. Knots.	Distances run in meters. 400	600	1000	1500	2000	3000
20	14.5	22.0	36.5	54.5	73.0	109.0
25	11.5	17.5	29.0	43.5	58.0	87.5
30	9.75	14.5	24.5	36.5	48.5	73.0
35	8.25	12.5	21.0	31.0	41.5	62.5
40	7.25	11.0	18.0	27.5	36.5	54.5
45	6.5	9.75	16.0	24.5	32.5	48.5

The table corresponds, as already stated, to an error of estimation of about 6° ; it may be seen that, under the conditions we have assumed, this error is of the same order of magnitude as the error which we assumed in the estimation of speed.

In fact, the absolute error is

$$E = T\Delta v - vT \cot \gamma . \Delta\alpha,$$

and the relative error is therefore

$$\frac{E}{vT} = \frac{\Delta v}{v} - \cot \gamma \Delta\alpha.$$

Upon our assumptions,

$$\frac{\Delta v}{v} = \tfrac{1}{20} = 0.05,$$

$$\cot \gamma \Delta\alpha = 0.364 \times 0.1 = 0.0364 ;$$

therefore, the two terms of the relative error,

$$\frac{\Delta v}{v} \text{ and } \cot \gamma \Delta\alpha$$

are of the same order.

Table II could furnish occasion for conclusions similar to those which we drew from Table I, on the subject of admissible ranges for firings at moving targets with existing torpedoes.

While we are considering the influence of a misestimation of the course of the target, we must emphasize the fact that this influence increases more and more as the line of fire departs from the normal to the target's path ($\gamma = 90°$) ; in fact cot γ varies from 0 to ∞ when γ varies from 90° to 0°. *There is therefore,* we repeat, *an enormous advantage in firing as nearly as possible normally; in departing from this principle we give to the errors made in estimating the course of the target a greater and greater importance.*

An example will demonstrate this: under the conditions above set forth, an error of half a point in the course of the target gives

an error at the target of 4.75 m. at 400 m., the torpedo making 45 knots and γ being equal to 70°. If γ is equal to 10°, all other conditions being unchanged, the error at the target, for the same error in the course of the target, would attain 74 m. at 400 m. The importance of the value of the angle γ is thus plainly shown; it is for this reason that the use of tubes without train may be a serious disadvantage; we have seen that a fixed angle of train imposes upon the assailant a fixed course in order that he may be able to make his attack under favorable conditions; if he is unable to follow that course, he finds himself under conditions more and more unfavorable in proportion as he departs from the course imposed by the conditions of pointing normally.

Influence of Two Simultaneous Errors: (1) in the Speed of the Target; (2) in the Course of the Target.—The general formula of the error at the target is

$$E = T\Delta v - vT \cot \gamma . \Delta a$$

in the case of errors of small value.

The partial errors are therefore algebraically added. Nevertheless, if it be desired to evaluate the approximation which may be counted upon, it is necessary, as is the rule in the theory of errors, to consider the total error as the *arithmetical sum* of the absolute values of the two separate errors; in fact, no hypothesis can properly be made as to the sense of the errors since they are independent one of the other.

By means of the two preceding tables, a third table can be drawn up corresponding to the following assumptions: speed of target 20 knots; error in estimating the speed of target 0.5 meters per second (about one knot); error in estimating the course of target 0.1 (about half a point); angle $\gamma = 70°$.

III.—TABLE OF TOTAL ERRORS.

($\Delta v = 0.5$ m. s.; $\Delta a = 0.1$; $v = 20$ knots; $\gamma = 70°$.)

Speed of the Torpedo. Knots.	Distances run in meters.					
	400	*600*	*1000*	*1500*	*2000*	*3000*
20	34.0	51.0	85.0	127.5	170.5	255.0
25	27.0	41.0	68.0	102.0	136.0	204.5
30	22.75	34.0	57.0	85.0	113.5	170.5
35	19.25	29.0	49.0	72.5	97.0	146.0
40	17.0	25.5	42.5	64.0	85.0	127.5
45	15.25	22.75	37.5	57.0	75.5	113.5

Errors computed to ±0.5 m.

An examination of this table shows, once more, the trifling gain which results from an increase in the speed of the torpedo for short ranges; if the admissible error is limited to 50 meters it may be further seen that firing at moving targets at ranges greater than 1000 meters with existing torpedoes is out of the question.

All this discussion supposes, be it understood, that the assumed errors (one knot and half a point) are such as an observer experienced in the conditions of a fight may make; if greater errors are admitted, our conclusions would thereby only be strengthened. In any event, whatever may be the assumption regarding the errors of estimation, it would always be the case that an increase of speed of the torpedo (beyond a certain figure, of course) does not sensibly increase the precision of fire at moving targets.

Resumé and Conclusions.—From what precedes we believe that we can draw the following conclusions:

(1) In firing at moving targets it is important to fire with normal pointing ($\gamma=90°$).

(2) Tubes with fixed angle of train are disadvantageous in firing at moving targets.

(3) Only a slight advantage can be gained from an increase of speed of the torpedo.

(4) It is impracticable to fire at moving targets at a range exceeding 1000 meters (in exceptional cases 1500 meters) so long as torpedo speeds do not greatly exceed 45 knots.

(5) In firing at stationary targets the speed of the torpedo is of little relative importance, but it is evidently necessary to increase the precision of pointing of the torpedo-tube in proportion as the range increases.

Modification of Sighting Apparatus.—In order to realize normal pointing ($\gamma=90°$), existing sighting apparatus might be modified in a simple fashion. The sighting apparatus consists diagrammatically of a graduated half circle A (Fig. 7). About the center O of this circle two alidades OB and OT can pivot independently of one another. OB is placed so as to be parallel to the course of the target and OT so as to be parallel to the axis of the torpedo-tube. Each of these alidades is furnished with a sliding leaf; the leaf b on OB is placed at b such that $Ob=\kappa v$ (κ depending on the graduations of the alidade), and the leaf t is placed at a distance $OT=\kappa V$. The triangle Obt therefore represents the triangle of velocities, and the torpedo should be fired in the direction Ot when the target is situated in the direction bt.

The angles Otb and Obt are, respectively, equal to the angles which we have called β and γ. The condition of normal pointing is $\gamma=90°$. To realize it, it would suffice to materialize bt by furnishing the sliding leaf b with an extension at right angles to the alidade OB.

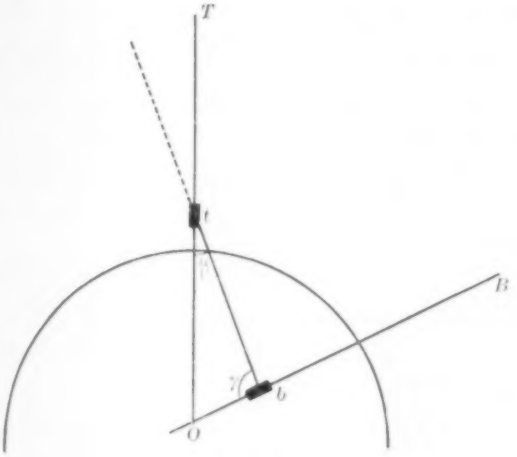

FIG. 7.

The operation of the apparatus thus modified would be as follows:

(1) The leaf b with extension would be placed at the point b representing the speed of the target.

(2) OB would be turned parallel to the course of the target.

(3) The leaf t would be placed at the point representing the speed of the torpedo.

(4) The alidade OT would be turned until the leaf t found itself on the extension born by the leaf b (extension normal to OB). The direction thus obtained would be that in which the torpedo-tube must be pointed.

There would then be nothing more to do but to fire at the instant the target arrived on the line of sight bt prolonged. The errors in estimating the course of the target would no longer have any effect (or, more exactly, they would have only an importance of the second order).

Influence of an Error in Estimating the Speed of the Torpedo.—In all that precedes we have supposed that no error was made in the speed of the torpedo. In reality, we can also be deceived in

the evalution of the speed, either in consequence of an error of adjustment of the pressure regulator of the motor, or on account of defective functioning, or from a current, etc.

Such an error will always be very small, but it is interesting, nevertheless, to ascertain its effect. If ΔV represents this error, a process of reasoning analogous to those already employed shows that the error at the target due to ΔV is represented by $vT\frac{\Delta V}{V}$; this term should be added to the two terms in Δv and Δa of the formula for the total error.

This error $E_4 = vT\frac{\Delta V}{V}$ likewise contains the factor T: we again find the importance of the duration of the run.

If we admit that the relative error $\frac{\Delta V}{V}$ in the speed of the torpedo is constant and corresponds to $\frac{1}{4}$ of a knot for 40 knots, the errors at the target corresponding to this error would be, respectively, $\frac{1}{8}$ of those inscribed in Table I (corresponding to $\frac{\Delta z}{v} = \frac{1}{20}$). From this proportionality it follows that all that we have said hitherto would still apply, in the case of an error in the speed of the torpedo, upon the given hypothesis.

If it be supposed that ΔV has a value not proportional to V, but independent of V, it will be seen that this hypothesis would lead to errors so much the smaller as V was greater; the speed of the torpedo would have, in this case, a great importance. Yet, in the total error, the term corresponding to ΔV should never be preponderant, since the knowledge which the assailant has of the qualities of his torpedo permit him to reduce to a very small quantity the error that he makes in the evalution the torpedo which he fires.

In any event, for a given speed of the torpedo, the error at the target resulting from ΔV is proportional to the duration of the run, that is to say to the range; this observation tends, like preceding ones, to limit the range at which a torpedo can be fired with a prospect of success.

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TORPEDO FIRE AT MOVING TARGETS.

THE EFFECT OF ERRORS IN THE ESTIMATION OF THE SPEED AND COURSE OF THE TARGET.

By PHILIP R. ALGER, U. S. Navy.

In translating the preceding article for publication in the PROCEEDINGS I was struck by the obvious absurdity from the practical point of view of Mr. Chapuis' conclusion that the assailant has no chance of success in firing a torpedo at a vessel which is heading directly towards him. Evidently, in such a case, the speed of the target would be quite immaterial, and, unless a large error was made in estimating the course of the target, the torpedo, if it went straight, could not fail to score a hit.

This discrepancy between mathematical deduction and common sense observation resulted, I soon saw, from the erroneous conception that the "error at the target" is the distance ahead or astern of the target at which the torpedo crosses the path of the target. As a matter of fact the true error at the target is the distance by which the torpedo misses the target—that is the distance of the torpedo from the target when the line joining them is perpendicular to the torpedo's path.

Looked at from this point of view, it was readily seen that, regarding the target as merely the point aimed at, it is equally advantageous to fire when the target is moving in the line of bearing of the assailant or at right angles to that line of bearing, and that the most disadvantageous condition for firing is when the course of the target makes an angle of about 160° with the bearing of the assailant. It is only when a material target, having length and breadth, is considered that the conclusion is justified that the beam presentation of an enemy offers the best chance for hitting him.

The following discussion of this subject will, it is hoped, be of more practical value than the original study which suggested it.

Since the errors made in estimating speed and course of target can themselves only be approximately known, it would be idle to attempt to deduce an exact formula for their effects. We shall therefore be satisfied with determining the separate effect of each of the two errors, knowing that the two results combined will be a sufficient approximation to the truth for all practical purposes.

Throughout we shall use the following nomenclature:

v = True speed of target,

$v+\Delta v$ = Estimated speed of target,

V = True speed of torpedo,

a = True angle course of target makes with course of assailant,

$a+\Delta a$ = Estimated angle course of target makes with course of assailant,

γ = Angle between bearing of assailant from target and latter's supposed course,

β = Angle between bearing of target from assailant and path of fired torpedo,

R = Distance of target when torpedo is fired,

T = Time from firing till torpedo intersects supposed path of target,

ΔT = Time before or after T when torpedo is on a line drawn from the target perpendicular to the path of the torpedo,

and at first we shall regard the target as a mathematical point.

Effect of an Error in Estimating the Speed of the Target.—Let OX be the path of the assailant, O being his position when the torpedo is fired, in the direction OQ, at the target A whose distance from O is $OA=R$ and which is moving in the line AX with the speed v.

The observer at O, supposing the speed of the target to be $v+\Delta v$, constructs the sighting triangle and fires his torpedo so that $OP=VT$ and $AP=(v+\Delta v)T$.

The target, really moving at the speed v, has only traveled vT when the torpedo has reached P, and consequently is at some other point B in the line AX.

At a certain interval ΔT after this, the target is at C and the torpedo is at Q, the line CQ being perpendicular to the path of the torpedo.

The distance CQ is the real amount by which the torpedo misses the target, or the lateral error due to the error in the speed of the target. We shall call this lateral error E_1.

From the given data we have

$$AP=(v+\Delta v)T,$$
$$OP=VT,$$
$$AB=vT,$$
$$BC=v\Delta T,$$
$$PQ=V\Delta T,$$

whence

$$CP=AP-AB-BC=(v+\Delta v)T-vT-v\Delta T=T\Delta v-v\Delta T.$$

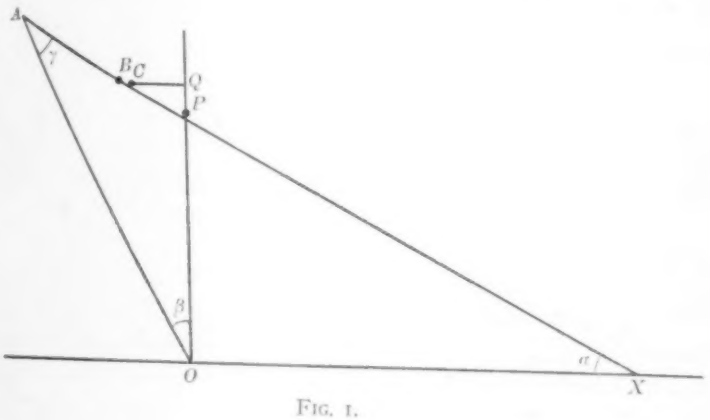

FIG. 1.

But, in the right angle triangle CPQ, the angle CPQ equals $\beta+\gamma$. Therefore

$$\cos(\beta+\gamma)=\frac{PQ}{CP}=\frac{V\Delta T}{T\Delta v-v\Delta T},$$

from which we get

$$\Delta T=\frac{T\Delta v\cos(\beta+\gamma)}{v\cos(\beta+\gamma)+V}. \qquad (1)$$

Moreover

$$CQ=E_1=PQ\tan(\beta+\gamma)=V\Delta T\tan(\beta+\gamma),$$

whence, substituting the value of ΔT from (1), we get

$$E_1=\frac{VT\sin(\beta+\gamma)}{v\cos(\beta+\gamma)+V}\Delta v. \qquad (2)$$

But, in the triangle APO,

$$OA \sin \gamma = OP \sin (\beta+\gamma),$$

or

$$R \sin \gamma = VT \sin (\beta+\gamma),$$

so that (2) may be written

$$E_1 = \frac{R\Delta v}{v} \cdot \frac{\sin \gamma}{\cos (\beta+\gamma) + \frac{V}{v}}. \tag{3}$$

Also, since

$$\frac{OP}{AP} = \frac{VT}{vT} = \frac{V}{v} = \frac{\sin \gamma}{\sin \beta},$$

we can replace $\frac{V}{v}$ by $\frac{\sin \gamma}{\sin \beta}$ in (3), and after a trigonometrical reduction, obtain

$$E_1 = \frac{R \tan \beta \sin \gamma}{\sin (\beta+\gamma)} \cdot \frac{\Delta v}{v} \tag{4}$$

In order to compare our results with Mr. Chapuis' $E_1 = T\Delta v$, we substitute $\frac{\sin \gamma}{\sin \beta}$ for $\frac{V}{v}$ in (2) and, after a trigonometrical reduction, obtain as another form for the value of E_1,

$$E_1 = T \sin \gamma \sec \beta \Delta v. \tag{5}$$

Far from its being impossible to nullify the influence of the error Δv, we have only to select a position such that $\gamma = 0°$ or $\gamma = 180°$ (target heading directly towards or directly away from assailant) and the value of the speed of the target becomes immaterial; the torpedo must hit if it is aimed at the target ($\beta = 0$ when $\gamma = 0$ or $180°$) and runs straight.

From (4) we learn that the error we are considering is directly proportional to the range R; is directly proportional to the relative error in the speed of the target $\frac{\Delta v}{v}$; and is zero when $\gamma = 0$, increasing with γ until it reaches its maximum value (for any given values of R and $\frac{\Delta v}{v}$) when γ is about $115°$, and then decreasing as γ increases further until it is zero again when $\gamma = 180°$.

Effect of an Error in Estimating the Course of the Target.— Let OX represent the course of the assailant and O and A the respective positions of assailant and target at the instant when the torpedo is fired in the direction OP. Let $\alpha + \Delta\alpha$ be the sup-

posed course of the target and α its real course, so that the target is thought to be moving with the speed v in the line AX while it is really moving with that speed in the line AX'.

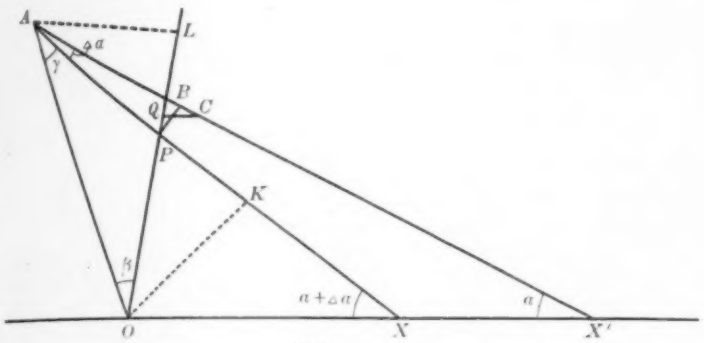

FIG. 2.

The observer at O, supposing the target to be moving in the line AX, constructs the sighting triangle and fires his torpedo so that $OP=VT$ and $AP=vT$. The target, really moving along AX', is at B ($AB=AP=vT$) when the torpedo reaches P, and at a time ΔT later, when the torpedo is at Q, is at C (QC perpendicular to OP).

The distance QC is, therefore, the real amount by which the torpedo misses, or the lateral error due to the error in the course of the target. We shall call this lateral error E_2.

From the given data we have

$$AP=AB=vT,$$
$$OP=VT,$$
$$BC=v\Delta T,$$
$$PQ=V\Delta T,$$
$$PB=AP\Delta\alpha=vT\Delta\alpha.$$

But the angle at Q is a right angle, and the angle at B is practically a right angle, and the angle between QC and PB practically equals the angle OPX which is $\beta+\gamma$. Therefore we have

$$PB=vT\Delta\alpha=PQ\ \operatorname{cosec}\ (\beta+\gamma)+BC\ \cot\ (\beta+\gamma)$$
$$=V\Delta T\ \operatorname{cosec}\ (\beta+\gamma)+v\Delta T\ \cot\ (\beta+\gamma),$$

whence we get

$$\Delta T=\frac{vT\Delta\alpha}{V\ \operatorname{cosec}\ (\beta+\gamma)+v\ \cot\ (\beta+\gamma)}. \qquad (6)$$

and also

$$QC=E_2=PQ \cot (\beta+\gamma)+BC \operatorname{cosec} (\beta+\gamma)$$
$$=V\Delta T \cot (\beta+\gamma)+v\Delta T \operatorname{cosec} (\beta+\gamma),$$

or, substituting the value of ΔT from (6),

$$E_2=\frac{V \cot (\beta+\gamma)+v \operatorname{cosec} (\beta+\gamma)}{V \operatorname{cosec} (\beta+\gamma)+v \cot (\beta+\gamma)} vT\Delta\alpha,$$

$$E_2=\frac{V \cos (\beta+\gamma)+v}{V+v \cos (\beta+\gamma)} vT\Delta\alpha. \tag{7}$$

Observing now that

$$VT \cos (\beta+\gamma)+vT=AK=R \cos \gamma,$$

and that

$$VT+vT \cos (\beta+\gamma)=OL=R \cos \beta,$$

we see that (7) can be written in the form

$$E_2=\frac{vT \cos \gamma}{\cos \beta} \Delta\alpha. \tag{8}$$

Comparing this with Mr. Chapuis' value $E_2=vT \cot \gamma\Delta\alpha$, we see that while both values vanish for $\gamma=90°$, it is far from true, as he concludes, that E_2 becomes indefinitely great as γ approaches zero.

To obtain the value of E_2 in the same form as that of E_1 (equation (4)), we substitute $\frac{R \sin \beta}{\sin (\beta+\gamma)}$ for vT in (8), thus getting

$$E_2=\frac{R \tan \beta \cos \gamma}{\sin (\beta+\gamma)} \Delta\alpha. \tag{9}$$

From (9) we learn that the error we are considering is directly proportional to the range R; is directly proportional to the error in the course of the target $\Delta\alpha$; decreases in value as γ increases from zero, until it becomes zero when $\gamma=90°$, and then increases (numerically) as γ increases further, until it reaches its greatest value when $\gamma=180°$.

The following tables give the values of the coefficients of $R\frac{\Delta v}{v}$ in (4) and $R\Delta\alpha$ in (9) for values of γ ranging from 0° to 180° for four assumed values of the ratio $\frac{v}{V}$; also the values of β corresponding to the stated values of γ. The ratio of 1 to 2 for speed of target to speed of torpedo is probably most nearly representative of present conditions.

EXPLANATION OF TABLES I, II, III AND IV.

γ is the angle the target's supposed course makes with the line joining target to assailant at the moment the torpedo is fired; for example $\gamma = 0°$ means the target is heading directly for the assailant, $\gamma = 180°$ means that it is heading directly away from him.

β is the angle the torpedo tube should make with the line of bearing of the target at the moment of firing.

R is the distance of the target at the moment of firing.

Multiplying the numbers in column three by $R\frac{\Delta v}{v}$, where $\frac{\Delta v}{v}$ is the relative error in estimating the target's speed, will give the distance by which the torpedo will miss the point aimed at due to the error Δv.

Multiplying the numbers in column four by $R\Delta\alpha$ where $\Delta\alpha$ is the error in estimating the target's course in circular measure ($1/5 =$ approximately one point), will give the distance by which the torpedo will miss the point aimed at due to the error $\Delta\alpha$.

TABLE I.

SPEED OF TORPEDO ONE-THIRD GREATER THAN SPEED OF TARGET.

$$\frac{v}{V} = \frac{3}{4}$$

γ	β	$\frac{E_1}{R\frac{\Delta v}{v}}$	$\frac{E_2}{R\Delta\alpha}$
0°	0°	.0	.4286
10	7 29′	.0759	.4306
20	14 52	.1585	.4364
30	22 01	.2565	.4443
40	28 49	.3792	.4520
50	35 04	.5397	.4529
60	40 30	.7522	.4343
70	44 48	1.0280	.3741
80	47 37	1.3623	.2402
90	48 35	1.7136	.0
100	47 37	2.0148	.3553
110	44 48	2.1917	.7977
120	40 30	2.2158	1.2793
130	35 04	2.0866	1.7509
140	28 49	1.8233	2.1729
150	22 01	1.4557	2.5214
160	14 52	1.0147	2.7879
170	7 29	.5195	2.9460
180	0	.0	3.0000

TABLE II.—SPEED OF TORPEDO TWICE SPEED OF TARGET.

$$\frac{v}{V} = \frac{1}{2}$$

γ	β	$\frac{E_1}{R\frac{\Delta v}{v}}$	$\frac{E_2}{R\Delta a}$
0°	0°	.0	.3333
10	4 59′	.0586	.3321
20	9 51	.1193	.3278
30	14 29	.1843	.3193
40	18 45	.2558	.3042
50	22 31	.3329	.2799
60	25 40	.4174	.2410
70	28 02	.5053	.1839
80	29 30	.5649	.0996
90	30 0	.6667	.0
100	29 30	.7221	.1273
110	28 02	.7482	.2723
120	25 40	.7379	.4260
130	22 31	.6881	.5776
140	18 45	.6031	.7175
150	14 29	.4828	.8362
160	9 51	.3370	.9258
170	4 59	.1700	.9820
180	0	.0	1.0000

TABLE III.—SPEED OF TORPEDO THREE TIMES SPEED OF TARGET.

$$\frac{v}{V} = \frac{1}{3}$$

γ	β	$\frac{E_1}{R\frac{\Delta v}{v}}$	$\frac{E_2}{R\Delta a}$
0°	0°	.0	.2500
10	3 19′	.0437	.2478
20	6 33	.0879	.2414
30	9 36	.1327	.2298
40	12 22	.1776	.2116
50	14 47	.2235	.1875
60	16 45	.2678	.1546
70	18 15	.3100	.1128
80	19 10	.3467	.0611
90	19 28	.3749	.0
100	19 10	.3920	.0691
110	18 15	.3946	.1436
120	16 45	.3804	.2196
130	14 47	.3506	.2942
140	12 22	.3039	.3628
150	9 36	.2426	.4202
160	6 33	.1688	.4639
170	3 19	.0864	.4904
180	0	.0	.5000

TABLE IV.

SPEED OF TORPEDO FOUR TIMES SPEED OF TARGET.

$$\frac{v}{V} = \frac{1}{4}$$

γ	β	$\frac{E_1}{R\frac{\Delta v}{v}}$	$\frac{E_2}{R\Delta\alpha}$
0°	0°	.0	.2000
10	2 29′	.0348	.1976
20	4 54	.0696	.1913
30	7 11	.1043	.1806
40	9 15	.1382	.1647
50	11 02	.1707	.1433
60	12 30	.2013	.1162
70	13 35	.2285	.0832
80	14 15	.2508	.0442
90	14 29	.2668	.0
100	14 15	.2743	.0484
110	13 35	.2725	.0992
120	12 30	.2604	.1503
130	11 02	.2375	.1993
140	9 15	.2047	.2440
150	7 11	.1625	.2815
160	4 54	.1126	.3092
170	2 29	.0576	.3265
180	0	.0	.3333

In order now to compare the total errors (E) which would result from firing under different conditions, we must fix the relative weights of the two partial errors E_1 and E_2. It seems quite certain that on the average the speed of the target can be estimated much more closely than its course. We shall assume $\Delta\alpha = 2\frac{\Delta v}{v}$, and to make the results more concrete we shall take $\frac{\Delta v}{v} = \frac{1}{10}$ and $\Delta\alpha = \frac{1}{8}$, or, in other words, we shall suppose the speed to be estimated with an error of 10 per cent and the course with an error of about one point (circular measure of 11¼° is .1964).

In Table V there are set forth, for values of γ from 0 to 180°, and for four different values of the ratio of speed of target to speed of torpedo, the values of the total error at the target divided by the range $\left(\frac{E}{R}\right)$ on the assumption that an error of 10 per cent is made in estimating the speed of the target and an error of about one point of the compass in estimating the course of the target.

The first set of figures in each double column is the arithmetical sum of the two partial errors divided by the range $\left(\frac{E_1+E_2}{R}\right)$; the second set is their arithmetical difference divided by the range $\left(\frac{E_1-E_2}{R}\right)$. Multiplying the former figures by the range will give the total error at the target if the partial errors are in the same direction; multiplying the latter figures by the range will give the total error if the partial errors are in opposite directions.

TABLE V.

VALUES OF $\frac{E}{R}$ FOR $\frac{\Delta v}{v} = 1/10$, $\Delta\alpha = 1/5$.

	$\frac{E}{R}$							
γ	$\frac{v}{V} = \frac{3}{4}$		$\frac{v}{V} = \frac{1}{2}$		$\frac{v}{V} = \frac{1}{3}$		$\frac{v}{V} = \frac{1}{4}$	
0°	.0857	.0857	.0667	.0667	.0500	.0500	.0400	.0400
10	.0937	.0785	.0723	.0605	.0540	.0452	.0430	.0360
20	.1032	.0714	.0775	.0537	.0571	.0395	.0453	.0313
30	.1146	.0632	.0822	.0454	.0593	.0327	.0465	.0257
40	.1283	.0525	.0864	.0352	.0601	.0245	.0467	.0191
50	.1446	.0366	.0893	.0227	.0599	.0151	.0457	.0115
60	.1621	.0117	.0899	.0065	.0577	.0041	.0433	.0031
70	.1776	.0280	.0873	.0137	.0536	.0084	.0395	.0063
80	.1842	.0882	.0764	.0366	.0469	.0225	.0339	.0163
90	.1714	.1714	.0667	.0667	.0375	.0375	.0267	.0267
100	.2726	.1304	.0977	.0467	.0530	.0254	.0371	.0177
110	.3787	.0597	.1293	.0203	.0682	.0108	.0471	.0075
120	.4775	.0343	.1590	.0114	.0819	.0059	.0561	.0041
130	.5589	.1415	.1843	.0467	.0939	.0237	.0637	.0161
140	.6169	.2523	.2038	.0832	.1026	.0418	.0693	.0283
150	.6499	.3587	.2155	.1189	.1083	.0597	.0726	.0400
160	.6591	.4561	.2189	.1515	.1095	.0757	.0731	.0505
170	.6412	.5372	.2134	.1794	.1067	.0895	.0711	.0595
180	.6000	.6000	.2000	.2000	.1000	.1000	.0667	.0667

The following conclusions may be drawn from an examination of Table V.

(1) The faster the torpedo relative to the target, the smaller the error. Assuming target speed to be constant, an increase of 50 per cent in torpedo speed will reduce the maximum error at the target two-thirds, an increase of 125 per cent will reduce the error five-sixths, and an increase of 200 per cent will reduce the error eight-ninths.

(2) The most favorable position for firing at a point (or at a target which presents the same area to attack from all directions) is when γ has a value of from 60° to 70°. In this position the partial errors almost balance one another if they happen to have opposite directions, and their sum, if they have the same direction, does not greatly exceed its minimum value.

(3) The faster the torpedo, the less important is the firing position. With torpedo only one-third faster than target, the error for $\gamma=180°$ is seven times as great as for $\gamma=0°$; with torpedo speed four times as great as target speed the error for $\gamma=180°$ is less than twice that for $\gamma=0°$.

In order to get a definite notion of the extent of the error likely to be made in firing at moving targets at various ranges, we will assume the ratio $\frac{V}{v}=2$, which closely approaches existing conditions, and calculate the error at the target which would result from a mistake of 10 per cent in the speed and of one point in the course of the target, supposing the two partial errors to be of the same sense.

TABLE VI.

MAXIMUM ERRORS (IN YARDS) AT THE TARGET.

$\frac{\Delta v}{v}=1/10$; $\Delta\alpha=1/5$.

γ	Range in Yards							
	250	*500*	*750*	*1000*	*1250*	*1500*	*1750*	*2000*
0°	17	33	50	67	83	100	117	133
10	18	36	54	72	90	108	126	146
20	19	39	58	77	97	116	135	155
30	21	41	62	82	103	124	144	164
40	22	43	65	86	108	130	151	173
50	22	45	67	89	112	134	156	179
60	22	45	67	90	112	134	157	180
70	22	44	66	87	109	131	153	175
80	19	38	57	76	96	115	133	153
90	17	33	50	67	83	100	117	133
100	24	49	73	98	122	146	171	195
110	32	65	97	129	161	193	226	259
120	40	80	120	159	199	239	279	318
130	46	92	138	184	230	276	322	369
140	51	102	153	204	255	306	357	408
150	54	108	162	216	269	323	378	431
160	55	109	164	219	274	329	383	438
170	54	107	161	213	267	321	374	427
180	50	100	150	200	250	300	350	400

It will readily be seen that, even when firing from the most advantageous positions, the chance of hitting a moving target at a range of 1000 yards or more with a torpedo having a speed not greatly exceeding 30 knots is extremely small.

Thus far we have considered the target to be a mere point; we must now take account of the fact that it has depth and width, and that while the former remains constant the latter increases as the course of the target approaches a perpendicular to the course of the torpedo.

If we call S the maximum area of the target—that is the area exposed when the vessel attacked is broadside on to the line of fire—it is easily seen that the general expression for the target area is $S \sin (\beta+\gamma)$. And if we assume, as seems reasonable, that the chance of hitting is directly proportional to the target area and inversely proportional to the error at the target (E), the numbers obtained by dividing the different values of $\sin (\beta+\gamma)$ by the corresponding values of $\frac{E}{R}$ (taken from Table V) should represent the relative advantages of the firing positions defined by the successive values of γ.

These numbers will be found in Table VII; only the maximum values of $\frac{E}{R}$ (those which are the arithmetical sums of $\frac{E_1}{R}$ and $\frac{E_2}{R}$) are used, and the target areas for $\gamma=0°$ and for $\gamma=180°$ are taken to be the same as for $\gamma=10°$, and for $\gamma=170°$ to take account of the fact that the target width never becomes less than the vessel's beam.

The most important conclusion to be drawn from Table VII is that there is a tremendous disadvantage in firing at a target moving away from one. Unless the speed of the target is abnormally great, the best chance of hitting is when the course of the target is at right angles to the path of the fired torpedo ($\gamma=90°$), but, while it makes very little difference if γ is somewhat less than 90°, there is a great falling off in the chance of hitting if γ is even 10° greater than 90°. With a very fast torpedo there is a good chance of hitting even if γ differs considerably from 90°, but it is always much better to have γ less than 90° than to have it greater than 90°.

TABLE VII.

NUMBERS PROPORTIONAL TO THE CHANCE OF HITTING.

γ	$\frac{v}{V} = \frac{3}{4}$	$\frac{v}{V} = \frac{1}{2}$	$\frac{v}{V} = \frac{1}{3}$	$\frac{v}{V} = \frac{1}{4}$
0°	3.51	3.88	4.61	5.40
10	3.21	3.58	4.27	5.03
20	5.54	6.42	7.83	9.29
30	6.88	8.52	10.75	13.00
40	**7.27**	9.89	13.18	16.22
50	6.89	10.68	15.10	19.14
60	6.06	11.09	16.87	22.03
70	5.11	11.34	18.65	25.16
80	4.30	12.91	21.05	29.42
90	3.86	**12.98**	**25.14**	**36.26**
100	1.97	7.90	16.48	24.58
110	1.12	5.17	11.51	17.69
120	.70	3.55	8.37	13.14
130	.46	2.50	6.14	9.87
140	.31	1.78	4.52	7.38
150	.21	1.24	3.22	5.34
160	.14	.81	2.12	3.56
170	.07	.41	1.09	1.84
180	.07	.44	1.16	1.96

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THE GENERAL PROBLEM OF THE RELATION BETWEEN TWO BEARINGS OF A SINGLE OBJECT AND ITS DISTANCE WHEN ABEAM.

By COMMANDER H. S. KNAPP, U. S. Navy.

There are several convenient thumb rules for piloting in places where only a single well-defined object is visible, of which the bow-and-beam bearing is probably the best-known. Another is doubling the angle on the bow; still another is the seven-tenths rule, given by Captain Gearing in Whole No. 123, U. S. NAVAL INSTITUTE PROCEEDINGS; and another is the $26\frac{1}{2}°-45°$ rule, given by Commander Muir in his excellent text-book.

While looking over Captain Gearing's note, in Whole No. 123, U. S. NAVAL INSTITUTE PROCEEDINGS, and Admiral Chester's discussion of it in a later number, it occurred to the writer recently that there is a general solution of the following problem:

Assuming a ship to be steering a steady course and to be unaffected by current or drift, find the relation between two bearings, from the bow, of the same fixed object ("relative bearings") such that the run between bearings will *equal* the distance that the fixed object *will be* when it bears abeam.

In the figure these conditions are represented, AC being the ship's course, F the fixed object, and $CF=AB$ by construction.

Evidently

$$CF\ (\cot\phi-1)=CF\ .\ \cot\theta. \qquad (1)$$

Whence

$$\cot\theta=\cot\phi-1. \qquad (2)$$

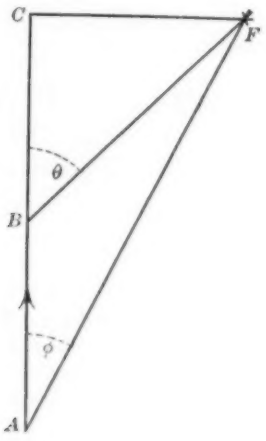
Equation (2) expresses the relation sought. To put it in a convenient form for computation, let

$$\cot\phi=\operatorname{cosec}^2 x$$
$$\tan\phi=\sin^2 x.$$

Then (2) becomes

$$\left.\begin{aligned}\cot\theta &= \cot^2 x\\ \tan\theta &= \tan^2 x\end{aligned}\right\} \qquad (3)$$

or



The following table has been computed from these formulæ. The angles in the first column are exact values; those in the second are the nearest quarter of a degree below the exact values in order to have a factor of safety. The marked pairs will probably be the most convenient ones to use, as they involve whole degrees only.

TABLE.

BEARINGS FROM AHEAD.

First	Second	First	Second	First	Second
20	29¾	30	53¾	41	81¼
21	31¾	31	56¼	42	83½
‡ 22	34	‡ 32	59	43	85¾
23	36¼	33	61½	44	88
24	38¾	34	64¼	45	90
‡ 25	41	35	66¾		
26	43½	36	69¼		
26	44¾	37	71¾		
‡ 27	46	38	74¼		
28	48½	39	76¾		
‡ 29	51	‡ 40	79		

This general solution includes the $26\frac{1}{2}°$–$45°$ rule, as it does the bow-and-beam rule. The use of the above table has the ad-

vantage, however, that the approximate determination of the distance off shore need not wait for the 45° bearing, as it must by the use of the 26½°–45° rule, or by the seven-tenths rule of Gearing. There are two whole-degree pairs by means of which such a determination can be made before the 45° bearing is reached. By the first pair (22°–34°) the observation is concluded when the second bearing is only 34°, while the first bearing itself is within a half-degree of the first bearing used in the seven-tenths rule, so that its accuracy is practically the same. The second pair (25°–41°) gives a check on the distance before it can be obtained at all by either of the two rules mentioned above. Of course the pairs having a fractional-degree value for the second bearing may also be used as further checks.

The use of the table is also more convenient than the method by plotting, though it does not fully take its place; and it is much more convenient than the use of tables 5A and 5B of Bowditch, though it does not fully take their place. Within the limits of its usefulness, however, the table appears to be an extension of present rules of thumb, and to be worth while.

A determination by this table is accurate to practically the same degree as by any other method in which the observations are made on the same bearings. It is obvious that the nearer to 90° the bearing, the more accurate the observation will be, because the more sharply defined.

By noting the run between successive pairs of bearings, any component of current toward or away from the fixed object (at right angles to the course) will be shown. If there is a shortening of the distance run from earlier to later observations (or a shortening of time if the speed is constant), there is a component of set toward the fixed object, and *vice versa*. Results obtained from earlier pairs in which the bearings are small, while not as accurate as those obtained from later pairs, may yet be counted upon sufficiently to give warning. It is possible to get five whole-degree observations by the time that the fixed object bears 30° forward of the beam, as follows:

22°–34°
25°–41°
27°–46°
29°–51°
32°–59°

Of these the last three should be reasonably accurate.

In case of a current directly with the ship, the apparent distance that the ship will pass from the fixed object when it bears abeam, using the table, is *less* than the real distance; this is on the side of safety except in a channel where there may be danger on the opposite side if too far away from the fixed object.

If there be a current directly against the ship, the apparent distance that the ship will pass from the fixed object when it bears abeam, using the table, is *greater* than the real distance. This is the dangerous condition, and if there be reason to suspect such an adverse current, or such a component of current, a maximum allowance should be made for it, and the distance found by observation be correspondingly reduced. Thus, with a twelve-knot speed and a two-knot estimated current directly against the ship, the observed distance off the fixed object should be reduced one-sixth.

These remarks about the effect of current are so obvious that their mention may seem unnecessary, but the writer imagines that every officer of experience has seen occasions, as he certainly has, when it was only too evident that a consideration of current did not enter into the philosophy of officers using some one of the methods of observing a single fixed object.

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REQUISITES OF THE BATTLESHIP BEST ADAPTED TO THE ITALIAN NAVY AND CONSIDERATION OF ITS TACTICAL EMPLOYMENT.*

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DESIRABLE AND POSSIBLE REQUISITES OF THE BATTLESHIP BEST ADAPTED TO THE ITALIAN NAVY IN VIEW OF THE LESSONS THAT MAY BE DRAWN FROM THE MOST RECENT PRACTICAL RESULTS AND FROM THE PROGRESS OF INDUSTRIAL TECHNICS.

Before the Russo-Japanese war, it was considered desirable to have on board of battleships several kinds of guns for piercing the various thicknesses of armor; the heaviest guns represented that part of the armament destined essentially to be brought prominently into action on closing the distance. A speed of from 18 to 19 knots was held to be sufficient for battleships; Italy alone, holding fast to the opinion, rarely abandoned by her, desired for the said vessels a speed superior to that of probable adversaries; and it seemed that, travelling in this direction, the differences between battleships and armored cruisers were destined to disappear.

Now, the general tendency, represented by the English *Dreadnought* type, and in other navies by the latest plans of battleships, is principally marked by guns of one caliber and by high speed. The heavy caliber with high initial velocity is held to be necessary for the greatest exactness and efficacy in long range firing; the single caliber is demanded principally because it carries with it the greatest facility for fire control.

High speed is held to be necessary for battleships as a strategical and tactical factor.

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To satisfy the all-big-gun conditions, the tonnage may vary between that which would correspond to a return to the single turreted monitor, and that of the huge battleship with many heavy guns; if it is found better to have on the same vessel 12 guns rather than 10, there is no reason for not preferring 14 to 12; the tendency is therefore toward an increase in tonnage, and it is impossible to say where it may be necessary to call a halt.

Even Austria, that owing to the moderate caliber thus far adopted for its battleships, and also to the small radius of action admitted as sufficient, had kept the displacement within modest limits, has now reached its maximum (14,500 tons) in the ships of the *Radetzky* type, now under construction.

While the general tendency is toward the single caliber, this is set aside by France and Austria-Hungary, who are arming their new vessels with guns of 305 and 240 mm.

This being understood, is it expedient for Italy to join the all-big-gun procession? Even admitting that such a course may be, in itself, rational, may it not be permitted to Italy to solve the problem of battleship types in a more economical manner than would result from adopting vessels of the *Dreadnought* type?

The life of heavy guns is very limited; could a nation with financial means as scant as our own profitably adopt a type of vessel, all the guns of which would have to be retubed after 60 rounds with full charges?

Admitting, because it is axiomatic, the necessity of constructing homogeneous divisions in a relatively short space of time, are the scant resources of our budget reconcilable with the construction of units each one of which costs not less than 50 million lire? And, if the single caliber mastodon is really necessary, is it rationally possible to devise an economical type yielding maximum returns? How, in such case, stand the limitations?

The replies to these questions constitute, in all essential particulars, the solution of the problem of the desirable and possible requisites in the type of battleship for Italy.

ARMAMENT.

The Different Types.—The greater the caliber of a gun, the flatter is its trajectory and the greater the residual velocity with respect to the gun of smaller caliber and with equal initial velocity; on the other hand, the latter has, on its part, the advantages of superior manageability and rapidity of fire. In other

words, the heavy gun has among its chief advantages that of greater danger space, or the greater latitude admissible in the estimation of the distance, and greater efficacy of a single shot; the superior manageability of the other is felt in a seaway, and especially if it permits of keeping the gun continually pointed at the target; such gun laying is not yet possible in the mounts of the heavier guns; but these latter have already made considerable advance in appropriating to themselves all the characteristics of the rapid-fire arm, having regard to the systems of breech closure, of loading, of training, of return to battery, etc.

The principal ways that present themselves for establishing the armament of a vessel appear then to be the following:

1. To prefer manageability and rapidity of fire to the greater danger space and the efficacy of the single blow, which would be obtained in the highest degree by keeping within the limits of medium caliber; it being possible to place on a vessel a large number of such guns, this number will compensate largely—in so far as regards the probability of hitting—for the smaller relative probability of each shot hitting. In order to fix the ideas, consider what this type of battery would mean to a vessel armed only with guns of 152 mm. or 190 mm., or to a battery of only 203-mm. guns, as in the Bettolo-Cuniberti type of 1899, considering the 203 mm. as taking the place of the 152 mm.

2. To apply the principle of the division of labor, by placing on one and the same vessel a few guns of heavy caliber and many of medium caliber; this is the well-known type of ship with four 305-mm. guns, and a numerous battery of 152 mm. or some similar caliber.

3. Seek out a compromise between the two foregoing systems, adopting a caliber between the mean and the maximum calibers, with the object of uniting the advantages of the two systems; to this type belong the new German vessels of the *Ersatz Bayern* class, armed with 14 guns of 280-mm. caliber.

4. Adopting in principle the preceding rule, but, not desiring to do away entirely with the gun capable of delivering a blow of maximum efficacy, give it part of the above-mentioned armament in place of a few guns of the compromise caliber; to this class belong the new French ships of the *Danton* type, having four 305-mm. and twelve 240-mm. guns, and the Austrian ships of the *Radetzky* type, with four 305-mm. and eight 240-mm. guns.

5. To adopt in principle the first type, with the addition of guns of heavy caliber; this type will bear the same relation to the first as the fourth bears to the third; to it belong our own vessels of the *Vittorio Emanuele* type.

6. To attribute great importance to the efficacy of every shot, without, however, entirely ignoring the importance of rapidity of fire, adopting the heaviest caliber with which we have succeeded in securing such perfection as to approximate its qualities to those of the rapid fire guns; to this category belong the English vessels of the *Dreadnought* type, and those planned or in construction in the United States, Japan, and Russia, armed only with 305-mm. guns.

7. Take a step still further in advance of the preceding by adopting the gun of the maximum caliber; to this category would belong the vessels armed with guns of a caliber greater than 305 mm.

It is to be noted that the nations that are now adopting the *Dreadnought* type of battery have already constructed vessels with batteries of the fourth type; thus England in 1905 launched the *Lord Nelson* type, armed with four 305-mm. and ten 234-mm. guns; Japan, the *Satsuma* types in 1906, with four 305-mm. and twelve 254-mm. guns; these navies did not believe that they could stop at these types that were for them but a transition to ships of the *Dreadnought* type.

In order to seek out the proper standards for establishing the type of battery most suitable to our battleships, we should fix the thought upon the importance of the various calibers. We may attempt to proceed in a theoretical way to the study of the probability of hitting, but the conditions of firing in naval battle are so complex that results obtained in that way are very elastic, the more so that, although admitting the existence of an undeniably rigorous process, this would always refer to the gun considered as isolated, whereas it is of capital importance to take account of the manner in which the various guns may be disturbed or favored by the action of others on board the same vessel.

No matter how uncertain and contradictory may be the data derived from the Russo-Japanese war, the change in the standards governing the types of vessels is nevertheless due to them, and is justly stated in the theme which we are endeavoring to examine. Let us then examine every one of the various parts of

our study, remembering that the contradictions among the writers on the results of the recent war are not solely due to deficiency of the data; studying these opinions attentively, it is often found that they depend upon a desire to justify previous conceptions and affirmations. It is not rash to say that in deliverance from these preconceived ideas must lie a great part of the secret of a just approximation to the facts.

Recent Lessons.—For our present purposes the separate consideration of the injuries sustained by the different parts of each vessel, is not of so much moment as the formation of some judgment as to what may have been necessary to the putting of the vessels out of action by means of gun fire, and as to how the attainment of this object may have been possible in view of the firing distance.

The battle of August 10, 1904, is the one from which we may extract some data for determining the efficacy of fire at distances greater than 6000 meters.

In the initial phase developed at a mean distance of 11,000 meters, the fire was suspended after a few minutes by both parties, because it was a useless expenditure of ammunition.

The second phase of the battle was that developed at distances not less than 8000 meters; in this also the results of the firing were small; the only noteworthy effect of which we have any notice was produced upon the Russian protected cruiser *Askold*. The effect to which we allude was that of a projectile which exploded on deck near the base of the forward smokestack, the plates of which were driven in, causing a diminution of the draft, and the splinters, falling into the boiler connections, perforated their tubes, obliging the isolation of the corresponding group of four boilers; the injury was not of great importance because the *Askold* had five smokestacks.

It is not important, for the object which we have in view, to consider the injuries of the *Askold;* but in the case of this vessel we confine ourselves to offering, for whatever they may be worth, two observations: 1st, that the aforesaid effect, the sole result of the greatest distance phase, was produced by a projectile of the caliber of 305 mm.; 2d, that the number of chimneys was what prevented the *Askold* from seriously feeling the damage.

The third phase of the action was begun at a distance of 7300 meters; both adversaries sought to concentrate the fire upon the

flagship, which was at the head of the line. Concerning the effects of the fire upon the Russian flagship, which was the *Cesarevitch*, we know that the most serious injuries, owing to which it was impossible either to follow the vessels that returned to Port Arthur or to attempt to reach Vladivostok, were:

(a) A shell that struck at the base of the foremast, passing through the right wall of the mast and exploding against the left wall.

(b) The damage produced by three shells striking the two smokestacks; the first made a hole, more than a square meter in size, in the forward smokestack, but the obturators remained intact and it was possible to continue the forced draft, the other two struck the after smokestack at top and bottom; the projectile burst while passing through the sides and riddled it over its entire height, rendering forced draft impossible, and enormously increasing the coal consumption.

(c) A shot under the armor on the starboard bow; the projectile burst on contact with the bottom, at the joint of two plates, of the outer plating, driving in plates, plate frames, and even the bracket plates; the bolts being broken owing to the driving in of the plates, the water entered through their holes, flooding the compartments adjoining the armored deck.

It is interesting to note that the five projectiles that produced the said principal injuries were of the caliber of 305 mm. and which, with others, struck the *Cesarevitch* during the phase of the action which took place at distances over 6000 meters, and before another projectile of 305 mm. exploded against the conning-tower.

Considering the total of the damage sustained by the *Cesarevitch*, it is found that the greatest effects were due to fifteen shots of heavy caliber, of which thirteen were of 305 mm., and two of 203 mm.; let these numbers be borne in mind in comparison with the number of the various kinds of heavy caliber guns which Togo had, that is, sixteen of 305 mm., one of 254 mm., and ten of 203 mm.; it would be absurd to make these numbers a basis of calculation, but they permit us to assert that the injuries sustained by the *Cesarevitch*, which, as is known, produced the confusion among the Russian ships and brought about their retreat to Port Arthur, are essentially due to guns of heavy caliber, and especially to those of 305 mm.

Naturally it is necessary to guard against a desire to generalize this result, which, in any case, is a single term in the sum of the considerations, of which the decisive ones are supplied by the battle of Tsushima.

As is well known, in that memorable battle, the Russians opened fire at 2.08 p. m., at a distance of about 6500 meters from the head of the enemy's column; the Japanese withheld their fire for about two minutes longer, at which time they were within the distance of 6000 meters. Togo writes in his report that at 2.45 p. m., the issue of the battle was decided; in truth the results obtained that day and during the night and day following are but the logical consequences of those produced in those first 35 minutes of firing.

In order to comprehend how this may have happened, we may ask ourselves: Is the result of the Japanese fire to be ascribed to the large or medium caliber guns? A superficial comparison of the situation of the two adversaries, limited to guns brought into action by the two parties, would be as follows: The Japanese had 56 heavy caliber guns against the Russians' 53; 305 medium caliber guns against 168; it might be observed that the Russians had, to a much greater extent than the Japanese, guns of an antiquated type, but, on the other hand, a greater number of guns of the maximum caliber, and besides, that at least a considerable part of the Japanese guns could not have been changed or retubed, and that hence they had corroded bores owing to the number of shots previously fired. The conclusion that in such case would appear logical would be that the two adversaries were about equal in the matter of heavy guns (if indeed the Russians were not superior), and hence the destructive effect of the Japanese fire would have to be ascribed to their great superiority in medium caliber guns.

Such a conclusion would seem to be confirmed by the fact that in the reports of the Russians mention is made of a *hail of fire* that covered their ships. But reasoning in this fashion we completely lose sight of a most important element, which is, *the tactical situation of the adversaries*. Concerning the movements of the squadrons there are no absolutely sure data to enable us to draw an exact plan of the movements, and we know that these certain data can never be had, because at the time of the action both parties were too much occupied to take exact account of

them; but the plan based upon Russian statements, published by Lieutenant White, of the U. S. Navy, in the *Proceedings of The U. S. N. I.*, and reviewed in the number of June, 1907, of the *Rivista Marittima*, is, for many reasons, believed to be nearest the truth. It permits the following deductions:

The object of the tactical maneuver of the principal forces of the Japanese (battleships and armored cruisers) united under the direct command of Togo, was that of maintaining themselves in positions practically equidistant from the enemy's leading vessel, concentrating their fire upon it. At 2.30 p. m., after 20 minutes of firing, when two battleships, the *Osliabia* and the *Kniaz Souvaroff* (that had been nearest the Japanese), had been obliged to abandon the line, while the Japanese guns were concentrating upon the *Alexander III*, the leading Japanese ship was about 5000 meters from the *Alexander III*, and their rear vessel about 4600 meters.

Thus the maximum difference between the distances at which Togo's ships executed their firing was 400 meters; on the other hand, while the leading Russian vessel was 4600 meters from the nearest part of the enemy's line, the other vessels were at greater distances, so much so that the rear of the line of principal forces was about 7200 meters distant, and the difference, 7200−4600, owing to the way in which the increase of the distance rapidly diminishes the probability of hitting, makes it plain to us how, by virtue of the tactical situation, even if between the two adversaries there had existed a parity of conditions from all other points of view, the fire of the Russians must necessarily have been less efficient than that of the Japanese.

It is therefore evidently established: 1. That the *hail of fire* must not be understood as expressing the action of the medium caliber guns, but the concentration of all the Japanese guns of heavy and medium calibers upon the nearest vessel of the enemy. 2. That in view of said concentration we cannot attribute to the medium caliber guns the virtue of having disordered and demoralized the Russian gun-pointers, preventing them from laying their guns well, because the Russian ships in the center and at the rear of the line enjoyed a relative tranquillity; but the gun-pointers were placed in conditions of inferiority by reason of the tactical situation. 3. The Japanese did not await the closing of the distance in order to open fire with their heavy guns, because, during

the first 20 minutes of firing, the distance between the nearest points of the two fleets varied only from 5500 to about 5000 meters.

In view of these deductions, the question which we are now discussing is limited to the examination of the relative importance of the heavy and medium caliber guns on the vessel concentrating her fire.

After the first ten minutes of firing the *Osliabia* was constrained to draw out of the line. In the beginning of the action, a 305-mm. projectile struck the port bow at the water line, at a point where there was no armor belt, and, owing to the heavy sea, two forward compartments were flooded.

Another projectile of heavy caliber made a hole in a coal bunker, very probably facilitated by the displacement of some armor plate, and the vessel listed to port; three other projectiles struck the forward turret and one damaged the lower part of it, while the third shot, that struck near one of the gun ports, disabled all the turret crew by wounds or asphyxia. A violent conflagration (reported by Togo) was seen from the Japanese line to manifest itself on board of this vessel, which under such circumstances abandoned the fight. In order to keep her afloat (raise the shot holes out of water?) a few of the starboard compartments were flooded, but the vessel continued to sink by the head, the gun ports of the lower battery could not be closed on account of their condition due to blows received (an effect that may be attributed to the medium caliber guns) so that the vessel continually listed further to port and capsized at 3.10 p. m. After the *Osliabia*, the Japanese fire was concentrated on the *Souvaroff*, which had become the nearest ship owing to the Russian formation in single line; said vessel was obliged to draw out of line at 2.30 p. m., with injuries that are not well known; we know that she had masts and funnels shot away and a fire on board, and that later she received the *coup de grace* from the torpedo-boats. In like manner, the *Alexander III*, with a fire on board, left the line, afterwards returned to it and definitely left it, and at 7.07 (when the artillery battle had ended) Kamimura's armored cruisers, which were then operating separately from the battleships, saw her capsize and go down. Concerning the *Souvaroff*, the *Alexander III*, and the *Borodino* (that took fire at 6.40 and sunk at 7.23 owing to an explosion of the magazines) Ferrand observes:

"qu'il est probable que l'artillerie pratiqua des brèches sur ces trois bâtiments; si l'on se souvient que la cuirasse épaisse était entièrement noyée, que la hauteur de la cuirasse mince de 152 mm. était, au moment du combat, au plus de 1m. 70 à 1m. 80 au dessus de l'eau, on admettra aisément que l'eau a pénétré sur le pont cuirassé par les brèches soit de la cuirasse mince, soit même à cause de l'état de la mer et du roulis, par des brèches au dessus de la cuirasse. L'invasion du pont devait diminuer la stabilité déjà réduite."

The fate of the battle of Tsushima was decided by that of the four best Russian ships above recorded; the brief considerations set forth suffice to show that the principal effects of the artillery at Tsushima were the following:

1. Fires on board due to heavy and medium caliber guns.

2. Sinking of the vessels due to heavy guns, owing to the large openings produced by their blows.

3. Disabling of the guns, due essentially to the heavy caliber guns.

We admit, however, that in the production of the fires, a great part of the results may belong to the medium caliber guns, by virtue of the great number of shots fired by them; but it must be taken into account that this happened on board the Russian ships under special circumstances; indeed the said ships had been overloaded with coal, and it is chiefly to the coal in the higher localities that such fires were due. Is it just, then, to draw from this a general deduction in favor of medium calibers?

Moreover, attributing to the medium caliber guns the *Osliabia's* inability to close her gun ports, this cannot supply us with an argument for keeping the aforesaid guns, because such a case would not arise with vessels having the guns in turrets.

A valid argument in favor of the medium caliber is the vulnerability of the chimneys, because, if the injuries of this kind sustained by the *Cesarevitch* were produced by guns of heavy caliber, that takes away nothing from the fact that the chimneys constitute the best kind of target for 6- and 8-inch guns; but before holding such an argument as sufficient for retaining these guns we ought to examine and see if there is not a way of rendering less dangerous this kind of injuries, that Mahan considers equivalent to the loss of a mainmast in former times.

Another fact is to be noted: those who expected to see the

armor perforated as on the proving ground have been sufficiently disillusioned. In part this may be attributed to the bad quality of the Japanese projectiles and in part to the general obliqueness of the blows; well and good. Against a vessel characterized by great extension of protected surface we could expect important effects from our fire in two ways: by the effects of perforation or destruction, and by the disabling of the organs of the vessel; in either case heavy caliber guns are necessary.

Summing up, the conclusions that seem unassailably to follow from what (considering the limited space required) we have briefly alluded to concerning the employment of the artillery in the recent war, are as follows:

1. Maximum importance of the heavy caliber guns; the necessity of obtaining rapid effects at the beginning of the action is axiomatic, because the advantage that may be gained thereby is a compound advantage, owing to the manner in which the enemy is thrown into confusion when, for example, the ship that is leading his line is quickly put out of action; hence it is of the highest importance to have efficacious means for action at the maximum distance; this maximum efficacious distance will in the future presumably be superior to what it was in the battles of the recent war owing to the progress in arms and in the means of fire control; hence it is logical to admit that the importance of the heavier guns may be a growing one and not a passing phenomenon.

2. The necessity of leaving to the heavy caliber guns the task of deciding the action between battleships being established, there remains to be studied how this battery of heavy guns may profitably be composed, bearing in mind that the necessity of requiring the efficacy of the single shot, imposed by the results of the Russo-Japanese war, requires us to follow a different way from that defined by the types of battery distinguished by the numbers 1 and 5, or more definitely, by the types whose principal characteristic is the large development of the 203-mm. guns. It is unnecessary to say that this is far from constituting a censure for those types of vessels, for when they were planned they appeared to be for Italy the best of its battleships; that was true with regard to the vessels of that time, in the same manner that the ships to be constructed to-day should be able to cope advantageously with those already planned or that may be planned.

Having thus made a first limitation for battery types, it is

proper to inquire if a certain number of medium caliber guns may not be necessary to the best employment of the heavy calibers in view of the defense against torpedo-boats. In order to proceed in this direction it is necessary to consider how the various battery types satisfy the requirements of fire control.

Battle Caliber and Regulating Caliber.—It is acknowledged that the best of the range-finders for naval artillery to-day existing is the Barr & Stroud; the type generally in use at present is that with the base of 1.80 meters, that gives an approximation of 80 meters at a distance of 4000 meters; of 180 meters at 6000 meters, and 320 meters at 8000 meters.

This approximation is certainly not ideal, taking into account that if we consider a vessel 120 meters long, 22 meters broad and 9 meters high at a distance of 5400 meters (6000 yards), supposing the vessel to be inclined at an angle of 45° with the firing plane, the danger space has the values shown in the following table:

Kind of Gun.	Angle of fall.	Danger space (meters).
152-mm. A. 91 Reg. capped projectile V. = 680 m. s..	9° 47′	61
152-mm. of the U. S. V. = 730 m. s.....	8° 30′	69
305-mm. of the U. S. V. = 730 m. s.....	4° 45′	117

The house of Barr & Stroud now announces a new range-finder having a base of 2.74 meters and an approximation of 40 yards at 6000 yards, and of 85 yards at 10,000 yards; such a range-finder would hence be able to give the distance with desirable approximation. However, we must bear in mind a hard and fast principle.

Even if the range-finder should supply the exact value of the distance, the fire control should always be based upon observation of the shots.

This principle results from the fact that the firing distances, or rather those to be transmitted to the sight-setters, must necessarily be different for the various calibers, the regulating corrections (correzione di regime) being different, particularly owing to the not inconsiderable differences that exist between the data furnished by the explosive at the acceptance trial and the averages assumed for the range tables, as well as on account of the differences (we here set down the principal ones) between the temperature of the explosive and the density of the air during the acceptance trials and the values of these important elements at the moment of tactical action.

Let us now refer to the firing in naval duel, from which we will endeavor to pass to squadron fire control.

From the aforesaid principle there follows as a corollary the necessity of having either a single caliber, or two calibers, between which, however, the differences in the columns of water thrown up by the projectiles at the point of fall are such that they may not be confounded with each other; whoever may have to direct the firing of a vessel armed with guns of 240 mm. and 305 mm. (Austrian and French type) will surely see a wide dispersion of his shots owing to the differences in the regulating corrections, and he will be unable to reduce this dispersion because the differences between the columns of water thrown up by the projectiles of the two calibers will not be sufficiently sensible.

The convenience of the single caliber lies in these considerations rather than in those of an organic character.

A second principle of fire control is that which recognizes in long range firing the impossibility of estimating the misses; to understand this it is only necessary to bear in mind that, at a distance of 5000 meters, a longitudinal miss of +400 meters or −350 meters subtends, at the eye of an observer, elevated 20 meters, an angle of 1′.

This being the case, there remains no other means except to base the improvement of the firing on the observation of the shots that fall short; consequently it is necessary that a considerable number of shots should strike simultaneously in such fashion as to form a rosette of shots, all fired with the same data. Rigorously, it would be necessary for this purpose to cause to be fired at the word of command a certain number of guns, greater than two, and to deduce, by theoretical rules, from the number of short shots, how far the center of the rosette is from that of the target, supposed to be lying flat.

In practice, firing by word of command, very logical with batteries composed of numerous pieces, naturally is not realizable with an armament of heavy caliber guns, and hence, independent firing is necessarily substituted, considering the shots fired within a brief interval of time as fired with the same data; in either of the two cases the improvement will be obtained without being theoretically hampered by a small number of shots falling short.

The methods of improving the fire are hence two in number:

The first seeks to regulate the fire of the heavy guns by observa-

tion of the fire of the medium calibers; as is well known, at any moment, from the range of the medium guns we may deduce the corresponding distance for the heavy guns, taking into account the relative regulating corrections of the two kinds of guns, these corrections to be determined not at the instant of battle, but from time to time (repeating the experiment with every fresh supply of ammunition) with the ship and target anchored, valuing as exactly as possible the differences between the misses, and bearing in mind the approximate rule that the relative regulating correction is proportional to the distance.

The second method is to improve the firing directly with guns of the principal caliber; this requires that the fire be continuous, the which includes rapidity of fire and a considerable number of guns of the said caliber on one and the same vessel; when these two conditions are wanting, recurrence to the first method is indispensable; in other words, it is necessary to make use of the medium calibers.

It must be remembered: 1. That the second method is not in conflict with the first, the great credit for which belongs to Commander Ronca, but it is a simplification of it permitted by the progress in materiel. 2. That the simultaneous application of the two methods is not excluded; that is to say that with an armament that permits the application of the second method, it might be a help to have a certain number of medium caliber guns, for this would permit of double control.

It being recognized that the task of deciding the action belongs essentially to a single heavy caliber, that we will call the *battle caliber*, the types of armaments, from among which, according to the foregoing, it remains to make selection, may be considered as divided into three categories:

1. A single heavy caliber uniting the double duty of battle caliber and a caliber for fire regulation; to make clear the idea, the armament that satisfies such a conception may be composed entirely of guns of 240 mm. or of 280 mm. (German type) or of 305 mm. (English type).

2. A single heavy caliber that satisfies the preceding conditions but with the addition of a medium caliber that lends itself to the constitution of the double control for fire regulation, and that may casually be effective against undefended parts; as well as adapted for anti-torpedo-boat action, with which we have not thus far

occupied ourselves. This conception is satisfied by the new Japanese type (guns of 305 mm. and 152 mm.) and the American type (guns of 305 mm. and of 127 mm.).

3. A battle caliber that does not lend itself directly to improvement of the firing, and that would have absolute need of the assistance of a regulating caliber, as above; under present conditions, there would belong to this category a vessel armed with guns of a caliber superior to 305 mm.

The addition of medium caliber guns to those of battle caliber being here considered advantageous, it is necessary to qualify the argument in favor of medium calibers by repeating the principle of Sims, that "a large number of medium caliber guns is harmful to the fire of the heavy guns." This comes from the fact that the hot gases produced by the fire of sufficiently numerous medium caliber guns, produces refraction of the line of sight, that becomes positive interference with the firing, or a diminution of the volume of fire—by virtue of which, according to Mahan, the medium calibers should be deemed superior to those of heavy caliber—and a diminution of the exactness of the fire of the heavy guns.

If then, the medium calibers are to figure in the armament, their number must be kept sufficiently small and their positions subordinate in order not to disturb the battle caliber.

Before proceeding further it is necessary to see if the conclusions now deduced can be maintained with regard to the fire control of united vessels.

This question is considered in relation to the tactical principle of the concentration of effort, or to the necessity that the various fractions of one and the same naval force seek to concentrate their offense upon one and the same fraction of the enemy, if not upon one and the same vessel, and that the vessels of the same fraction seek to concentrate their fire upon one and the same ship.

This principle, which has been recognized for a long time, was, at Tsushima, realized in the famous "hail of fire," with which we have already occupied ourselves; it implies considerable difficulty in the observation of the results. The questions that arise are the following: Of what use are the deductions previously drawn if it is going to be impossible to distinguish our own shots from those of another vessel? Will not the dispersion be so wide as to justify the French and Austrian type of armament with two heavy calibers?

Concerning shots fired by many vessels, which fall simultaneously about the target, it does not seem possible to carry out the observation of the short shots, since it is possible to befall that one ship may fire short, another too far, and that we may declare ourselves satisfied (with our performance).

If, however, at a certain moment, we may be able to render the fire observable as that of a single vessel, we may assure to ourselves such advantage also for the continuation of the fire. To this end it is necessary, in the same manner pointed out for the determination of the relative correction between heavy and medium calibers, to determine said relative correction between the heavy calibers of the different vessels. This being granted, the flagship A of the fraction of the naval force that is being considered, may issue instructions that he will open fire when he estimates himself at the distance X; in order that another vessel B may consider its own shots as composing a single rosette with those of the vessel A, it is necessary: 1st, that the measures of the distances of A and B from the enemy's vessel upon which they are to concentrate, may practically be considered as affected by the same error; 2d, that B apply on beginning the firing the relative correction of the guns of A. The first condition will not be satisfied by means of independent telemetric measures since the exactness of the telemeter will not be sufficient; but it may be reached in the following way, based upon the hypothesis that A has taken care, at that initial moment (or after a suspension of the firing) to place himself in such position as that the other vessels of his section may all see him, in order to measure exactly their distance from him. The vessel B measures with the telemeter the distance BA, and solves by means of alidades, the triangle having one side BA, another side X, and an angle formed by BA and the line BE, joining him with the enemy's vessel upon which concentration is to be made.

At the moment in which A commences firing, the side BE so deduced will be affected by an error, for size and for sign, identical with that committed by A's range-finder, when, as far as X is concerned, the error on AB may be neglected. The difference between the initial firing distance determined in the manner just explained and the distance from the enemy simultaneously furnished by one's own range-finder, will furnish each vessel with the necessary guide to the end that, the firing once commenced,

this may be continued, basing itself upon the indications of one's own range-finder and on the observation of the short shots.

The possibility of carrying out such a system shows how arduous would be the problem of a good fire control of a naval force, when each vessel has more than one battle caliber; the arguments set forth for the case of an isolated vessel are therefore strengthened.

Fire Regulating Caliber and Anti-Torpedo-Boat Caliber.—The recent war has shown the absolute necessity of not leaving the anti-torpedo-boat guns unprotected, because in such case they will in all probability be put out of action during the combat between the vessels; it is sufficient to recall the fact that on the *Gromoboi*, after the battle of August 14, out of 24 guns of 76 mm., only two were still serviceable. It is proper to remark here (because this is in relation to the type of gun that we are seeking) that the protection may be realized in two ways: 1. By mounting these guns only at the conclusion of the action between the vessels. 2. By keeping them mounted, but protecting them with a sufficient thickness of armor; for obvious reasons it is well that these medium guns should be the same as those that in the preceding paragraph have been considered in connection with fire regulation.

Restricting the torpedo defense guns to those of the first kind, we should have an armed vessel of the *Dreadnought* class, having guns of 305 mm., and guns of 76 mm. with arrangements for dismounting; but it is clear that we must keep mounted at least a considerable number of 76-mm. guns, because otherwise a day attack of torpedo-boat destroyers would certainly succeed, and hence it would be necessary to resort, as the English have done, to the expedient of having the torpedo defense guns very much scattered, so that the bursting of a single shell could not dismantle a large number of them at one and the same time. Such an arrangement is not acceptable because it keeps the anti-torpedo-boat guns unprotected; therefore we must have recourse to the second of the two systems above mentioned, employing the first as an auxiliary, that is to say, in order to intensify the defense against nocturnal attacks.

There is necessary then, besides the heavy caliber guns:

1. A caliber adapted to the regulation of long distance firing, for action against the unprotected parts of vessels, and against torpedo-boats. Evidently it must be a gun whose rapidity of fire

and precision at long range is sufficient for the purposes above mentioned; hence it must be a gun of medium caliber. The caliber will be determined, as we shall see, in relation to the number of guns of this kind.

2. A caliber smaller than the preceding, having the exclusive task of repelling torpedo-boats; as they are not to be kept in position during the combat between ships, they must be easily manageable for mounting and dismounting; they must therefore be of small caliber.

Selection of the Heavy Caliber.—A fundamental idea that ought to guide us in all the various questions of the theme that we may unfold, is the following:

The problem would be dealt with in a one-sided manner if we should limit ourselves to studying our type of battleship in relation only to the most recent vessels of other navies, or even if we should propose to ourselves only to reach such results that a group of these vessels might confront in the best manner a group of ships of the aforesaid type; it is necessary instead that the type of vessel should be considered in the more general way imposed by strategical and tactical exigencies, or considering the action of the group, the requisites of which we wish to determine, in relation to the conduct of the fleet already existing.

Since we are now to discourse concerning the armament let us note that Austria, until the new vessels now planned, has held it sufficient not to advance beyond a gun of 240 mm.; we have deemed necessary a superior heavy caliber.

This being understood, in order to fix the ideas of the points of advantage of having a superior heavy caliber, let us consider, for the Armstrong guns of 305 mm. and 254 mm. (which we may hold to be about equivalent to the 240 mm.), the maximum angle of incidence R with the normal, at which they are able to perforate modern Krupp plate of 152 mm.:

Distance in meters.	Guns of 305 mm.	Guns of 254 mm.
3000	43°	35°
6000	39°	25°

NOTE.—The above numbers are calculated with the formula:

$$R = \frac{2}{3} \text{ arc cos } \frac{V_0}{V},$$

in which V is the residual velocity at the distance considered, and V_0 is the velocity necessary for the perforation of the plate with normal fire (calculated with the Krupp-De Marre perforation formula); the formula reported is no other than the well-known one of Louel that gives good results in proving ground practice.

These figures show us how, as between two vessels *A* and *B* having the same thickness of side armor, the ship *A* which has the superiority in maximum caliber can permit herself to bring *B* a noteworthy number of degrees nearer abeam than the other can do without greater risk; this difference becomes more marked as the distance increases.

If now we consider the Austrian types of battleships we find: 1st, that the *Monarch* types have 15 cm. of side armor; 2d, the *Habsburg* types have 100 mm. abreast of the coffer-dam and 135 mm. on the casemates of the 152-mm. guns; 3d, the *Erzherzog* types have above the belt a thickness of from 120 mm. to 150 mm.

Taking into account these thicknesses of armor, and the field of fire of the guns, we find that an Austrian vessel when engaged in a struggle with a vessel armed with 305-mm. guns, in order to fire with the maximum number of her guns, will be obliged to present her side in a direction in which it will be vulnerable.

It is remarked that in the simple case of combat between two vessels, it is easy to maneuver so as to keep the bearing of the enemy between a direction which limits a sector of maximum offense, and the direction nearest the beam in which the side is least vulnerable to the enemy's more powerful guns, this latter direction to be determined by the impossibility of perforating the armor which covers the greater part of the side. The wider the angle between the two directions just mentioned, the greater the liberty of maneuvering of the vessel under consideration. In squadron combat the inclination of the single vessels will be of secondary importance compared with the advantage of having all the vessels in good tactical position; for example, in position to *T*, or in positions equidistant from the nearest part of the enemy's line: the advantages of position of the kind that Togo secured at Tsushima are greater than the risks represented by a few vessels that expose this armor normally.

In any case, the smaller these risks, the greater liberty of maneuvering the fleet will have: whoever, then, has the superior caliber will be in the better conditions.

If the maximum caliber adopted for the new ships of the other navies were that of 240 mm., we might be able to discuss the propriety of accepting for our own the gun of 280 mm.; but, given the armament of the new types, we are limited in our choice to the gun of 305 mm. or to one of still greater caliber, since we may

not select an inferiority, disadvantageous for the reasons before given.

It is necessary at this point to keep in mind the recent progress made in artillery. The 240-mm. Skoda gun has peculiar excellencies that up to now have not been realized in guns of superior caliber; the progress to which we allude consists precisely in the extension of these excellencies to the 305-mm. gun. With the wedge breech closure and the charge contained in cartridge cases (of which the fabrication has so far progressed as to present the desired requisites) the 305-mm. guns destined to arm the new Austrian ships possess very noteworthy conditions of safety, rapidity, etc.

The caliber of 305 mm. is, at the present time, that which unites the maximum efficacy of the single blow to the characteristics of a rapid fire arm. To go beyond this caliber would be, on our part, a renunciation of these excellencies; the gun of superior caliber that would be adopted, in order to possess a high initial velocity, would have a shorter life than the 305-mm., and we may say at once that a heavier ship would be required. The argument in its favor would be that of maintaining in our types that superiority in caliber they have had until now with regard to those of the Austrians, but we may say that our type armed with guns of 305 mm. will always have that superiority with respect to the Austrian battleships which precede their newest type, and that even in this respect there will exist a superiority in the desired sense, because on our part we shall have an armament of 305-mm. guns, while in the Austrian and French types appear also the 240-mm. guns. Consequently it is at present neither necessary nor convenient for Italy to go beyond the caliber of 305 mm.; that may be accomplished in the future if our probable adversaries themselves adopt for their future types the all-big-gun armament of 305-mm. caliber, and if the heavier guns become more manageable.

Having thus selected our battle caliber, the next question is naturally the following:

How many guns of 305 mm. ought to be placed on our type of vessel, and how should they be distributed?

Principles of Concentration (of Artillery Materiel) and of Maximum Return.—When the ram had the character of the predominant tactical arm, it was logical to consider the number of the ships as constituting in itself an important factor of victory.

As the principal task belongs to-day to the gun, in order to determine if it may be profitable to concentrate one's own artillery in a restricted number of units, without referring to the tactical details which we will discuss in Chapter II, it will suffice to fix our minds upon the advantageous tactical situations which we have already pointed out in connection with the lessons of the recent war. In general it may be affirmed that, the object of tactical maneuvers being the concentration of offense upon one part of the enemy, this concentration will be so much the more easily obtained the more the means of offense are assembled in a few units.

As an illustration we may observe that an advantageous tactical position is that in which our ships execute their firing, being all at approximately the same distance from the enemy's vessel upon which they are concentrating; if we have a certain number of guns assembled in one and the same vessel A, we are on that account in better condition than if we had the same number of guns divided between two vessels B' and B'', because these two vessels would have to obtain by maneuvering the advantage that A obtains by construction; if the ships of the A class maneuver well, it will be easier for them to secure the desired tactical position than it would be for ships of the B type.

Therefore we are brought to admit the convenience of having ships with as many guns as possible; it must, however, be observed:

1. That having a certain number of heavy ships instead of a greater number of small ships, the effects of the enemy's offense are more sensible, that is to say, the enemy, concentrating his offense upon one of our vessels, disturbs the fire of a greater number of our guns, and the loss of a unit signifies the loss of a greater fraction of the whole.

2. That, consequently, the smaller the financial resources of a nation, and the more the theater of war in which its forces must operate lends itself to the employment of torpedo-boats, so much the more must it recognize the necessity of placing itself only conditionally in the path leading to concentration of offense in a few units.

For economical, tactical, and strategic reasons, in the type of battleship for Italy, we ought to establish a compromise, weighing in the balance the value of concentration, and that of distribu-

tion; to the end that this compromise may not be established in an arbitrary manner, we must have recourse to the idea of the *maximum return.*

For this purpose it is sufficient to remember:

(a) That the advantages of having as many guns as possible on one and the same vessel depend not at all upon the number of guns in an absolute sense, but upon the number of guns that can fire simultaneously upon the same target.

(b) That a vessel will generally have a single target to fight.

(c) That for battleships the development of offense in the broadside sectors is of greater importance than ability to fire in the line of the keel.

These three axioms concur in causing us to seek for the heavy caliber guns a distribution which permits to every one of them a field of fire on both sides of the vessel; the third in particular makes us bear in mind the necessity of providing in a special manner for the broadside fire; but as the relative potentiality of the broadside fire and of that in the direction of the keel, varies with the amplitude of the lateral sectors of maximum offense, we must ask ourselves if there may be logically established a limit for this amplitude. It would be irrational to limit the development of the fire in the direction of the keel below what is compatible with said limit, holding to which, we may, given a certain number of guns, distribute this number in the most rational manner. This being granted, the third axiom will lead us to determine the armament with maximum return on the basis of the following rule:

The increase of the number of guns is rational so long as it increases the potentiality of the broadside fire, but if there exists a limit, beyond which the increase in the number of guns favors only the fire in the direction of the keel, that limit ought not to be exceeded, and it is likewise not profitable to remain below it.

Amplitude of the Sectors of Maximum Offense.—In the naval duel as well as in squadron combat, it is very desirable to be able to impose the fighting distance which is deemed most advantageous; let us here occupy ourselves with the requisites necessary to this end in the naval duel, leaving it to the second part of this study to determine if the characteristics decided upon for our type satisfy the conditions of combat between assemblages of ships.

It will be of assistance to keep in mind the axiom that in Chap-

ter II will permit us to solve the problem of the best fighting distance; this says that in this problem it would be absurd to pretend to seek a fixed number and to demonstrate, for example, that 5200 meters is a more advantageous distance than 5100. Truly the elements which must be taken into account are varied and complex; consequently, instead of a fixed value for the distance, we ought to seek out the limits between which it is best that the distance be included, or in other words, we must know if it is better to fight at long range or at medium range.

This being granted, the hypotheses that may be made concerning the maneuvers of the enemy, in order to deduce the necessary and sufficient amplitude of the sectors of maximum offense for our ships, are the following:

1. The enemy's vessel N has our vessel I in a sector of maximum offense.

2. The vessel N has I in line with the keel.

In the case of the first hypothesis, in order to be sure of being able to impose the distance, it is necessary to have at least one of the following advantages:

(a) Greater speed.

(b) Greater amplitude of the sectors of maximum offense.

At first sight it may seem preferable to seek to obtain the condition (b) because speed is a very costly element; but let it be noted that for a number of tactical and strategical reasons, of which we will speak in their turn, there is required for our type of vessel a speed two knots greater than that of the types of the most probable adversaries; hence we may be sure of being able to impose the distance if we have sectors of maximum offense about the same as those of the aforesaid types.

Now it is well known that in the new French and Austro-Hungarian types the 240-mm. turrets are at the sides, and that, just as in our ships of the *Vittorio Emanuele* class, the forward and the after turrets have a field of fire of 135° from the line of the keel; thus in these vessels the sectors of maximum offense cannot be extended beyond about 45° counting from the beam.

In our type of vessel, with regard to the hypothesis of the broadsides battle, we may then hold sectors of 45°, counting from the beam, to be sufficient.

Let us now consider the hypothesis that N has I in the direction of the keel, and let us put the question: Would it be possible for

I to impose the distance, keeping *N* in a sector of maximum offense? The speed of *I* being 22 miles, that of the Austrian type 20 miles, and that of the French type 19 miles, the amplitude *a* of the sector under discussion (counting from the beam) would be given by the formula Sin $a = \frac{V_n}{V_i}$, or it would be equal respectively to 89″ 40′ and 59° 50′. The first of these amplitudes is absolutely unattainable, and hence against a ship of 20 knots speed, the maneuvering of *I* must alternate the bearing in the direction of the keel and that in a sector of maximum offense. In this case, then, the question is answered negatively.

As an illustration, let us suppose that *I* wishes to fight a ship of 20 knots' speed, keeping the distance between the maximum distance at which the fire is effective and a distance (minimum) of 2000 meters.

The duration of each period of end-on battle, which would depend only on the difference of speed, would be about 33 minutes; the duration of each period of broadside combat would vary with the amplitude of *I's* sector of maximum offense, and, for amplitudes of 45°, 60°, and 70°, would be respectively 10 meters, 21 meters, 51 meters. But it is to be observed that if the enemy's vessel is being chased, the ship *I*, when it has given up the end-on fire in order to reach the amplitude of 60° or 70° of the sectors of maximum offense will be obliged to remain for the first 33 minutes in a very disadvantageous position; as the amplitudes just mentioned would evidently require the arrangement of all the turrets on the longitudinal axis, the inferiority of our type could not but be very sensible; hence the fact of the possibility of being caught in this position of great inferiority, reduces to a secondary place the advantage (otherwise very questionable) that, with amplitudes of 60°, we should have with respect to the French type, being able to impose the extreme fighting distance.

It should be stated here that the reconciliation between an amplitude of 60°, counting from the beam, in the sector of maximum offense and the potentiality of the fire in the direction of the keel seems to be reached in the *Michigan* type of the United States, all four of whose turrets, each one containing two 305-mm. guns, are on the longitudinal axis, but four guns can fire in the line of the keel, owing to the different heights of the emplacements. In this system, each of the turrets nearest the center of the ship

stands higher, and, therefore, is heavier and exposes a larger target than would be the case with turrets of which the guns were all on the same level.

Aside from this, such an arrangement involves the inconvenience of the interference of fire already mentioned in connection with the fire of the medium caliber guns in relation to those of heavy caliber; this might be remedied by salvo firing, but it is well understood that the commandant of each turret must have autonomy in order to carry on the fire of his guns.

Among the desirable and possible requisites in the armament of our type of vessel, let us then place the following:

1. Strength of fire in the direction of the keel that can compare with that of the new French and Austrian types.

2. The turrets should be placed so as to have a field of fire on both sides; but, as we exclude the case of the guns of one turret firing over those of another, it is necessary that some of the turrets be removed from the longitudinal axis.

3. Sectors of maximum offense extended to 45°, counting from abeam.

Distribution and Number of the Heavy Guns. (See Plate I.)—Since the armament of our vessel is composed of guns of 305 mm., these should be placed in pairs in turrets, because it is well recognized that the two-gun turret represents the best compromise between the advantages of the concentration, and that of the dispersion of the heavy artillery.

We must now inquire in what way the armament composed of a certain number of two-gun turrets may satisfy the condition previously deduced, to which may be added the axiomatic condition of having the same strength of fire before and abaft the beam, because naval tactics teach us that there exists no plausible reason for desiring the contrary.

This being granted, for the vessel with two turrets, not wishing to limit the fire in the direction of the keel to two guns only, it would be necessary to place the turrets on a line inclined to the axis, in a way that would be a return to the *Duilio* types: it is clear, however, that such an armament is not the one with maximum return that we are seeking.

For three turrets, the ideal arrangement would be on a diagonal, with a fire of six guns in the direction of the keel and six guns in the broadside sectors; but such an arrangement is evidently not

practicable while the motive power remains as at present. In general, whatever may be the armament, we may exclude the possibility of arranging three turrets on the same diagonal. In the report presented this year to the "Institution of Naval Architects" by the member McKechnie, on the theme "The Influence of the Engines upon the Artillery of Modern Battleships," we find a sketch of a vessel with five turrets, three of which are on a diagonal; but the author considers that this would only be possible if gas motors were adopted and chimneys abolished. This idea being excluded, the ship with three turrets must then have the emplacements on the longitudinal axis; placing, however, the middle turret near the forward one, we shall have a greater field of fire forward of the beam, and it will result analogously if the middle turret is removed toward the stern.

On this account, in order not to limit the fire in the direction of the keel to two guns only, and owing to the fact that in passing from six to eight guns we increase the broadside fire, we arrive at the vessel with four turrets.

To the end that the disposition of the artillery of this last vessel may respond to the conditions already established, it must needs be that shown in Fig. A, Plate I, that is to say, with two turrets placed in the usual way on the longitudinal axis, and two placed laterally on a diagonal. Reserving to ourselves the right to investigate this arrangement later on, let us notice how, at first sight, it is capable of permitting a broadside fire of eight guns and a fire in the direction of the keel of six or four guns, according to whether or not it is possible to fire No. 2 astern and No. 3 ahead.

In a vessel with five turrets, not being able to place the fifth on the diagonal with 2 and 3, we are obliged to put it on the longitudinal axis, but, *a priori*, we know that, leaving the other four turrets arranged as in Fig. A, the vessel would be excessively long; we are, therefore, obliged to remove turret No. 3 toward the bow (or No. 2 toward the stern), placing it abreast of No. 2, and limiting the field of fire of these turrets to one side only. In this way we have the arrangement shown in Fig. B, which arrangement is that of the *Dreadnought*.

It is stated that in the *Dreadnought* the turrets 2 and 3 can fire directly astern; if this were not so, the vessel with ten guns would be inferior to that with eight guns, since she would be able to fire astern with a single turret only; and as there is no reason for

thus sacrificing stern fire to that of the bow, or *vice versa*, such an arrangement is to be condemned. If then it is a fact that the turrets Nos. 2 and 3 in the English types can fire over the stern, the same possibility must be admitted for the turrets bearing the same numbers on the ship with eight guns; so that the ten-gun vessel has the same potentiality of broadside fire as the eight-gun vessel, and no improvement is made on the arrangement in Fig. A.

In the ship with six turrets, the disposition is that which would result from placing turret No. 4 of Fig. B at the side, and locating the new turret abreast it on the other side, as shown in Fig. C. This vessel could fire with eight guns on each side, and with six in the direction of the keel. While, from what we have said, the passage from the ship with four turrets to one with five, is not logical, either from the point of view of broadside fire, or from that of fore and aft fire, the ship with six turrets is logical when owing to the arrangements of Figs. A and B, the impossibility exists of firing with turrets 2 and 3 astern as well as ahead. Consequently the passage from the vessel with four turrets to one with six turrets is rational only if the fore and aft fire of the vessel with four turrets is deemed insufficient.

To obtain an increase of broadside fire over that of eight guns in Figs. A, B, C, we must have recourse to the vessel with seven turrets, thus obtaining the disposition shown in Fig. B (*Ersatz Bayern*); the increase of another turret brings the arrangement of Fig. E, or that of the *Danton*, which maintains the potentiality of fore and aft fire unaltered, that of Fig. E bearing the same relation to Fig. D as the arrangement of C bears to B.

Summing up, the potentiality of the fire in relation to the number of guns is shown by the following table:

Number of guns.	Fore and aft fire.	Fire in sectors of maximum offense.
8	4 or 6	8
10	6 at one end, 2 or 6 at the other end	8
12	6	8
14	6 at one end, 2 or 6 at the other end	10
16	6	10

From the foregoing it results that the armament giving the maximum return, which we are seeking, is that with four turrets

disposed in the manner shown in Fig. A; the advantage over this arrangement that might be attributed to that of Fig. B (*Dreadnought*) would be that, for example, in the case of the disabling of turret 2, the vessel might present her port broadside and continue firing with eight guns; but the *Dreadnought* type would have no advantage, if, instead of one of the turrets 2 and 3, one of the others was disabled. In order to have a real advantage in this sense, it would be necessary to recur to the arrangements of Figs. C and E. Hence the choice must be made between vessels armed with 8, 12, or 16 guns. The preceding discussion establishes the fact that, for Italy, the vessel with four turrets is the best.

Arrangement of the Four Turrets.—With modern emplacements, a turret with two guns of 305 mm. can fire beside another in the same plane (past it, and in the same direction with it), or in a slightly different plane, when the distance between the planes passing through the centers of the turrets parallel to the plane of fire, is seven meters.

Since for various reasons easy to comprehend it is important to us to have the turrets Nos. 2 and 3 of Fig. A, Plate I, at the least possible distance from the longitudinal axis, this distance must then be seven meters, and, considering the radius of the armored tube to be 4.50 meters, the transverse section of the vessel abreast the said turrets must measure at least 2×7 plus $2\times4.50=23$ meters.

It is besides important that the turrets Nos. 2 and 3 be as near as possible to the center of the vessel, because, if proposing to ourselves the contrary, we hope to reduce to the minimum the weight necessary for protection by forming two redoubts containing respectively the turrets 1 and 2, and 3 and 4, on the other hand in the manner just mentioned, we accomplish a better distribution of the weights, and we increase the possibility of having a fire of six guns in the direction of the keel. In order to determine the maximum value of the angle B between the diagonal 2-3 and the longitudinal axis Fig. 1, let us consider the right-angled triangles: $2KO$ and $23P$, in which, designating the angle $23P$ by Y, $2K=2P=3K'=7$ meters.

$$B+Y\leqq45^\circ.$$

The value of B which we are seeking is $B=30^\circ$, and the corresponding value of $B+Y=44^\circ$, or we have a field of fire of about

46°, counting from the beam. In order to fix the idea, let us note that this gives the distance KK′ as about 25 meters.

Given this disposition of the lateral turrets, those on the longitudinal axis, to the end that they may permit to the former a fire in sectors of 45°, should be at a distance from the center of the vessel of not less than 26 meters; if these turrets were further removed toward the extremities, their field of fire could be greater than 270°.

It being thus established that our type of vessel should have two turrets on a diagonal inclined 30° to the longitudinal axis, and two turrets on the said axis, let us now settle the armament of medium and light guns.

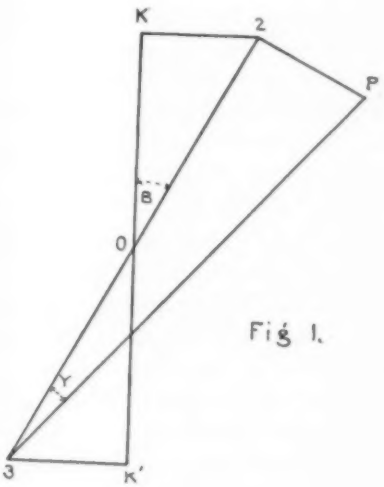

Fig 1.

Guns of Medium and Small Caliber.—If we were obliged to limit ourselves to a single heavy caliber and an anti-torpedo-boat caliber, it would be necessary to have recourse to the 100-mm. gun that is the heaviest with which semi-automatic working is possible.

*Having, however, recognized the necessity of a gun of medium caliber adapted for the regulation of the fire and for daytime action against torpedo-boats, it is necessary, as we have already said, that the guns of this caliber be protected by a sufficient

*The 102 mm. gun exhibited by the Armstrong firm at the Exposition of Milan hurls a projectile 14 kilograms with an initial velocity of 869 m. s., and has practically the same rapidity of fire as the 75 mm. gun.

thickness of armor, adequate for the conditions of long range combat. They must be arranged in a way that will not disturb the fire of the heavy caliber guns, and hence they should be located on a plane below that of the 305-mm. turrets, should be few in number, but with a wide field of fire. The arrangement in casemates does not satisfy these conditions; we must avoid a repetition of the case of the *Osliabia*, and the arrangement in turrets is necessary. We should have, then, four turrets, so disposed that each pair of them may be able to fire in the direction of the keel as well as in the sectors of maximum offense (a field of fire of 135° from the longitudinal axis); each of these pairs of turrets is to be placed in an intermediate transverse section between an extreme and a central one of the heavy gun turrets. Given this arrangement, since there is required in the medium caliber gun to be adopted precision in long range firing, we maintain that it is best to have on our type of vessel eight 152-mm. guns of the new model of 50 calibers, that hurls a projectile weighing 45.4 kilograms, with an initial velocity of 930 m. s. and of which the rapidity of fire may be worked up to ten shots a minute. Since the French, as well as the Austrian, ships of the types already constructed have many parts unprotected, it will be very opportune to make up the armament (of our vessels) in this manner.

Finally for the guns of small caliber, having the exclusive task of defending against torpedo-boats, with arrangements for dismounting, it is necessary to adopt the heaviest caliber that answers to these requisites, in order to obtain the maximum exactness of fire and the maximum efficacy of the single blow; an armament of twelve 76-mm. guns seems to answer the purpose well, these guns being placed, half of them in the extreme bow, and half at the extreme stern.

It may be objected that the eight 76-mm. guns that are on deck at the stern and on the forecastle of the *Dreadnought*, and that are to be removed from position during battleship action, have shown that the frequent mounting and dismounting of these pieces causes a too rapid deterioration of the carriages and sights. Several propositions have been made for the elimination of these inconveniences, among which is that of the adoption of disappearing carriages. There is no doubt that a solution can be found.

Ammunition Supply.—It is calculated that at Tsushima the Japanese fired on an average 75 shots per gun of heavy caliber;

the number of shots fired by each one of the 305-mm. guns must have been less than that. At any rate it is better to take this number as a basis for establishing the allowance for each piece for combat between ships, than to take into account only the rapidity of fire. It is admitted by all to-day that a naval battle will not be an affair of ten minutes, but it must be remembered that when we say that at Tsushima the artillery battle lasted from 2.08 to 7.23 p. m., that is very far from meaning that every vessel fired uninterruptedly.

Moreover the battle is substantially decided by the putting out of action of the principal ships; no matter how much better protection these ships may have than those that fought in the last war, yet the increase in offensive means by the concentration of heavy guns presented by the new types should make us abstain from exaggerated opinions. With this we desire to say that from the guns will be required the maximum effort, that is to say, the maximum rapidity of fire with the best projectiles, only in the aforesaid initial phase, that is effectively also the decisive phase of the battle, because all the rest is a logical sequence.

An ammunition supply kept within reasonable limits in order not to overload the ship, and answer to the necessities of war, seems to be the following:

Guns of 305 mm.—One hundred rounds, of which 75 are capped projectiles with high explosive charges, and 25 are projectiles adapted for coast operations, but capable on occasion of being fired with battering charges; for this purpose these last 25 projectiles should have not only an equal number of full charges, but also a certain number of battering charges, 10 for example.

Guns of 152 mm. and of 76 mm.—Given the task assigned to these guns in the vessel of the new type (differing from that in other types already existing), the ammunition supply should be composed of H. E. shells. In order to have the greatest flatness of trajectory these projectiles should be discharged with the highest initial velocity; it is a question of the careful study of projectiles and explosives. We may hold it sufficient to have 250 rounds for each 152-mm. gun, and 300 for each 76-mm. gun, taking into account the fact that in general the guns on both sides will not be simultaneously in action.

Torpedo and Ram.—There remains to be defined the equipment of our vessel with respect to the other two naval arms.

We can have no illusions concerning the outcome of torpedo discharges from a long distance; in order to have a sufficient probability of hitting it is not enough to increase the run, because we must bear in mind the effect of an error in estimating the speed of the enemy.*

The under water launching tubes cannot be destroyed in a long range action, and remain always a powerful means of offense on closing the distance, and also the most efficacious last resort of a vessel unable to move.

May we exclude close action? This form of struggle being that in which the unforeseen has the greater dominion, it may result the most opportune for whoever must place his greatest hopes in the unforeseen, or for the party that desires to reverse the fortunes of long range battle, or that *a priori* knows that he is unable to fight advantageously at long range owing to material inferiority or minor ability. Nevertheless this inferiority will not be admitted *a priori;* furthermore, even when one of the adversaries may believe that he has the greatest aptitude for close action, the hope of proving superior to the enemy in maneuvering

* Letting S denote the half length of the target, c the run of the torpedo, V its speed in m. s., the error in m. s., in the estimation of the speed of the target in order to hit it, must not be greater than

$$\Delta = \frac{Vs}{c}.$$

The new turbine torpedo of the United States, that has a diameter of 254 mm., has a speed of 28 miles per hour for a run of 3200 meters, and a speed of 36 miles for a run of 1100 meters. The corresponding values of Δ are respectively 0.3 m. s., and 1 m. s. We must then, besides the radius of action, increase also the speed of the torpedo in proportion to the run, to the end that the same error may correspond to the same missing distance S. In order to have with the most modern type of torpedo above mentioned with 3200 meters' run, the probability of hitting corresponding to 1 m. s. of error in the estimation of the enemy's speed, the torpedo would need to have a speed of 104 miles per hour. In the present state of things the sufficient probability of hitting a vessel in motion with a torpedo must then be considered as from a distance of about one kilometer. An argument that would remain in favor of the long discharge would be that a torpedo discharged at a ship that formed part of an assemblage, if it did not hit its target, might hit another neighboring vessel. But we ought to reflect that if a number of vessels are arranged in single line, the distance between ships of 300 meters or more is sufficient to eliminate such chances, and we must hold that a torpedo discharged at a definite vessel would either hit that vessel or it would hit nothing at all.

and in firing will make him first attempt the long range combat. Consequently, only after a long range action will the party who feels his situation to be the worst seek close action; his adversary will seek to avoid that form of action.

Unless the combatant placed in conditions of inferiority possesses superior speed, close action cannot be obtained; without need of running the risk of torpedoes, a vessel or an assemblage of vessels has in its artillery the means of giving the *coup de grace* to an adversary.

If then we were reduced to desire a close action, the torpedo armament would not enter effectively into action, whenever, although we have the superior speed, the enemy can succeed in keeping us a considerable time under fire before we can succeed in closing the distance; it is not well, however, totally to suppress the under water launching tubes, because otherwise the enemy could, by closing in, more easily give us the *coup de grace* with his guns, while we should be able to act in such fashion that the enemy, in so doing, would risk compromising the advantage he had obtained.

The conclusion at which we arrive is that of reducing the outfit, as have Austria and the United States, to two lateral under water launching tubes, capable of discharging a torpedo with the ship at high speed, because the study of tactics demonstrates the necessity of this condition.

As for the bow tube, the torpedo guide (guidasiluri) is not sufficient to make it trustworthy with the run at an angle, and only Germany and Russia have adopted it; the stern under water tube exists in the new and newest English, Japanese, German, and Russian types, but if we analyze the question of the increase of radius of action of the torpedo, due to the enemy bearing astern, it is found that the increase is illusory, and hence, in order that a stern tube may be held to be necessary, we must imagine a case that is too improbable, that of a ship absolutely stopped.

As to the ram, there is to be considered:

1. The scant probability of ramming; it is easily demonstrated that no matter how little mobility it may have, a ship may always succeed in changing a direct blow into a scraping alongside.

2. That a close struggle will rarely be seen.

3. That the modern ship does not need to attempt to ram.

For these reasons, the possibility and the convenience of abandoning the ram is to-day well recognized.

PROTECTION

Protection against Artillery.—In order to draw deductions in this regard from the recent war, it is necessary to place the systems of protection face to face with their performances. The reliable data that we possess are few, but nevertheless they are sufficient for the following observations of a general character.

The Russo-Japanese war has confirmed the necessity of a complete waterline belt. It is sufficient to recall the cases of the *Osliabia* and of the *Asama;* it is well known that this armored cruiser was obliged to withdraw temporarily from action because three projectiles had struck her astern near the waterline. It concerns us now to ask: Is the necessity of sacrificing to the protection of the waterline that of the higher parts—the French opinion—demonstrated or not?

Whoever has observed the Russian battleships of the first Pacific squadron must have noted how far they were from having the lines provided for in their plans; thus, for example, the heavy belt of 400 mm. of the *Poltava* types, to which the protection of the upper parts was so greatly sacrificed, was in great measure a dead weight.

The same thing occurred on the vessels that fought at Tsushima; according to the reports of Commandant Klado, on leaving Libau, the upper edge of the belt in the four ships of the *Souvaroff* type was only 60 cm. above the water. As this was the case with the normal coal supply of 1750 tons, Engineer Ferrand justly observes that on going into battle, when the coal supply was 2500 tons, the armor belt was entirely submerged and the protection was reduced to that of the 150-mm. armor, extending 1.70 meters above the water.

Naturally we may place against such occurrences the affirmation that the plans of the ships ought to be studied carefully so that, on going into battle, they may not have conditions so different from those called for as the Russian ships had, but for this purpose it is necessary for the waterline belt to have a height that may permit the draft to vary between rather ample limits. Also, aside from the hypothesis that a vessel may have several compartments flooded, whoever is obliged to fight far from his own bases (as may be our case) should foresee the necessity of having on board the maximum supply of coal.

All this shows that, the necessity of protecting the vital zone of the waterline being admitted, we must seek to increase the height of the protected surfaces, while it would be a great mistake to limit too much the said height in order to increase the thickness of the armor.

The recent war has demonstrated the necessity of reconciling the French type of protection, that looks essentially to the protection of the waterline, with the Anglo-Italian type, that limits said protection in order to have a continuity of protected surface in the central part of the vessel. Said necessity was already recognized, and the protection of vessels for the past few years has followed the idea; the war, then, has given us nothing new in this respect; however, the difference between the two above mentioned still substantially exists, because if we all agree concerning the parts to be protected, doubts arise concerning the thickness of the armor.

The results, the causes of which we must seek out, are thus briefly summed up: It has been possible to keep modern type cruisers (those of the Japanese) very usefully in the line with the battleships; in general the perforations that were looked for have not been effected. How can this be explained? An explanation may be found in the inclination of the plates to the plane of fire; if we look at the drawing of White above cited, it is perceived that at Tsushima the firing was executed under conditions very different from those of the proving ground.

Ferrand observes that this explanation does not suffice: "Un projectile de rupture pésant 340 kg. et capable de perforer à 4000 m. une épaisseur de 456 mm. d'acier harweye, devrait défoncer, sous une incidence quelconque, des plaques de 100 mm. ou de 150 mm. Si aucun cas ni de perforation ni de défoncement n'a été observé, il faut ou déclarer la faillité de l'artillerie, ou plutôt se demander si le canon et le projectile japonais étaient tels que nous le figurons." The excellent French engineer does not take into account the way in which the resistance of the plates increases as the angle of incidence departs from the normal; the formula of Louel, already mentioned, and upon which we may base ourselves because the practice of the proving ground confirms it, tells us that a plate of the thickness s, exposed normally to fire, is about equal, so far as concerns the effects of the firing, to a plate of the thickness $\frac{s}{3}$ that receives the blow at an angle of

40°. There may be established under such conditions the equivalence between 450 mm. of armor and 150 mm. inclined. This serves for the plane armor, and as for the curved armor it is very difficult to give it a normal blow; the inclination is then an element to be kept very much in mind; the poor quality of the ammunition, which seems to be confirmed by both the adversaries, should have contributed to this.

This being granted, how are we to protect our vessels against capped projectiles of heavy caliber and of the best quality?

We must now consider the armor ordinarily inclined to the line of fire; only exceptionally will it be found exposed to receive the blows normally; and this will be for fleeting instants, if our maneuvers are inspired by sane tactical criteria. Thus, for example, even when we consider the hypothesis of vessels passing each other steaming in opposite directions (logically and strictly, in close battle only), the moment in which the beam is presented will be but a passing one. Shall we seek to put ourselves in condition to remedy this exception? No, because solution is impossible; even admitting the possibility of having plates capable of resisting the guns, we can only protect a very limited portion of the ship; the weight thus employed would be, in great part, a dead weight under ordinary conditions, or with the vessels inclined to the line of fire, because it is clear that a defensive weight greater than is needed, is a weight that gives no return. Therefore, the rule for determining the thickness of armor based on perforation with normal fire is not to-day applicable, owing to the development of the heavy calibers, and battle studies demonstrate that even aside from this it is to be abandoned; this brings about a limit rule which would be the adoption for the guns of a caliber like that of the *Duilio's* guns, with the hope of being able, with a normal blow on the armor, to put the enemy's vessel out of action.

It is better to resolve to secure relative invulnerability under ordinary conditions, and this recognition of the general obliquity of the blows does not militate against the use of capped projectiles, because if the cap is useful under angles of incidence approaching the normal, it is not disadvantageous with oblique firing, and hence it is better to adopt it in general.

Let us denote by s the maximum thickness of armor that the enemy's heaviest gun can perforate at a sufficiently short distance, say 1000 meters; from what has been previously said, deeming

40° the average angle of incidence we can admit that the thickness $\frac{s}{3}$ may satisfy the case of oblique fire at any battle distance whatever. For the gun of 305 mm. (which is at present the heaviest on the French and Austrian vessels), the thickness $\frac{s}{3}$ thus determined gives 150 mm.; in order to have a margin of safety, let us adopt armor of 200 mm.; there is no reason for exceeding this thickness in any part of the vessel, while the maximum caliber of the guns of our probable adversaries does not increase.

Deeming these 200 mm. quite sufficient as well for the flat armor plates as for the curved ones of the 305-mm. gun emplacements, this limit may be exceeded for the conning-tower in view of the small increase in weight that it represents and of the importance of protecting the *brains of the vessel;* for the turrets of the 152-mm. guns, however, in view of their secondary importance, we may decide upon the minimum limit of 150 mm. In a general way the system of vertical and horizontal protection to be adopted is that of the *Vittorio Emanuele* type with the reduction of the central portion of the belt from the thickness of 250 mm. to that of 200 mm., and with an increase in thickness at the extremities from 50 mm. to 100 mm. In this way we maintain the valuable feature of the *Vittorio Emanuele,* that of having a considerable height protected by 200 mm. of armor, and by increasing the thickness of the bow armor we protect the high speed which has formed and must form one of the essential characteristics of any type of vessel adapted to Italy's needs.

In order to protect the high speed it is necessary also to seek to diminish, with respect to the vessels already existing, the vulnerability of the smokestacks.

We cannot, under present conditions, suppress them entirely during action; in order to do this it would be necessary, as Ferrand proposes in his report above cited, to have funnels to be lowered during action, closing their passages, using forced draft, and making the smoke conductors discharge through the side. But in the discussion of the aforesaid report by the "Association Technique" it was justly observed that with this system there would be created about the ship an asphyxiating atmosphere besides not having room above for the necessary horizontal conductors.

The already cited cases of injuries to funnels suffered by the *Askold* and the *Cesarevitch* in the battle of August 10 makes us reflect:

1. It would be desirable to have numerous funnels, but with the adoption of the heavy caliber battery, in order not to obstruct the field of fire of the gun on both sides of the ship, it is well to limit the funnels to two well separated from each other. 2. For battle purposes it is necessary to consider the forced draft as normal and to protect the funnels below the obturators with at least 10 cm. of armor.

The upper part of the funnels should be of very thin plates, and, since the tendency to-day is toward the adoption of a single projectile, armor piercing and exploding, supplied with delayed action fuze (as is made necessary by the extension of the armor plating on the new types), we may hope that generally we may not have explosions on impact with such plates.* In any case it is still necessary that the armor plating of the funnel should extend a little above the obturator, up to an armored grating, in order to avoid the fall of splinters. The strength of the draft will permit the reduction to the minimum of the section and height of the funnels.

Protection against Under Water Weapons.—The protection of the bottom against submarine weapons still awaits solution, that is absolutely necessary owing to the probable action of submarines in the next coming war and owing to the effects of torpedoes in the Russo-Japanese war.

We have discontinued the use of torpedo nets, and even in the navies that still keep them opinion is not favorable to their use when under way; we must seek to load down our battleships as little as possible, and hence it is not well to have on board of them such means of protection but on board auxiliary vessels that accompany the fighting forces.

With a ship in motion, the greater its speed, so much the more is it defended against automobile torpedoes, owing to the smaller probability of success in launching. Taking into account the action of the various kinds of torpedoes we will indicate in the second part special cruising formation for battleships.

* We may hope for this in fighting against a vessel armed with heavy caliber guns only; this makes it so much the more necessary for us on our part to have guns of 152 mm. that can fire projectiles capable of bursting against such plates.

As for anchored torpedoes, the possibility of there being opened, with due diligence, a passage through a mined zone is not to be excluded, but, notwithstanding this, every battleship represents an element so precious and of such relative importance that it is imperative directly to protect its bottom, replacing the present double bottom, useful only in cases of stranding.

In the battleship *Cesarevitch* the protection against torpedoes was obtained by bending down the armored deck. When the vessel was torpedoed on the night of February 8, 1904, the under water armor was driven in but not broken; nevertheless, four compartments were flooded, and the defect of this system of protection stands out in the fact that it did not protect large spaces from being flooded through a leak in the outer plating.

Whatever the system of armor plating of the bottom such mishaps could not be avoided. Indeed the armor plating may be held to be useless unless it is placed inside at a sufficient distance from the bottom, because its theoretical basis is corroborated by the way in which the effects diminish the farther the center of explosion is from the vital structure of the vessel. But to accomplish this either the transverse sections of the vessel are greatly increased and there is a great loss of speed that cannot be said to be compensated by the gain in stability of platform, or recourse is had to a very considerable thickness of armor which has a much greater weight, and the displacement of the vessel increases, as is well known, about three times that weight. In order that it might be possible to place armor able to resist submarine weapons at a sufficiently short distance from the bottom, it would be necessary to have found an adequate structure to be substituted for the present double bottom; but then we may confide the defense solely to this structure and lay the armor aside. This last is the way in which it seems that the protection of the hull should be sought, bearing in mind that the effects of the explosion are undoubtedly greatly diminished when, as Ferrand observes, the gases of the explosion have free way upward.

The study of this internal structure more capable of resistance than that in use at present is laid upon the engineers of all nations, and it is very comforting and flattering to us that Engineer Cuniberti affirms that he has already solved the problem. (See articles entitled: "A New Ideal Ship," published in *Fighting Ships* of 1906-07.)

SPEED AND FUEL.

In order to establish the standards concerning the maximum speed to be sought for in the type of battleship, it is sufficient to reflect how our strategical problem presents itself, considered under the two general hypotheses of the offensive and the defensive.

Whenever we may find ourselves in the case of having to fight far from our bases against a weaker fleet, it will be to our greatest interest to give decisive battle as soon as possible; there can be no doubt that the enemy's interest would be directly the contrary, on account of the wear and tear of our vessels due to the lack of permanent and temporary bases for the heavy ships, and owing to the diminution of force due to the conditions in which we must accomplish our coaling operations.

The methods to which the supposed enemy's fleet could have recourse would be reduced to the two following:

1. Undergo a blockade, remaining in one of his principal bases.

2. Regulate his action by the standard of the maximum activity compatible with the inferiority of his forces, utilizing special conditions of the seat of operations, keeping himself in positions previously prepared, having various exits, and hence capable of conferring a probability of success on a maneuver on internal lines, whenever our forces divide themselves in order to watch the different outlets.

It seems logical to hold that the second method would be the one applied at the beginning of the war. On our part it would be necessary to put ourselves in condition to surprise the enemy, depriving him of the possibility of fighting us singly, and the following distribution of the battle forces would be required: (a) the main body in position to threaten the enemy's communications with the more important of his principal bases; we risk nothing in presuming that, generally, this would apply also to the exigencies of land and sea co-operation; (b) in a central position with respect to the exits of the interior basin in which the enemy is found, maintaining a squadron of contact capable of refusing tactical contact with the main body of the enemy, but otherwise capable of maintaining strategical contact. The most profitable strength for this squadron may be determined in time of peace by keeping count of the present composition of the forces of a supposed adversary and of his vessels under construction.

Let us suppose, for example, that we may deem sufficient for this purpose the division of the four armored cruisers of the *San Giorgio* type. A condition evidently necessary for the main body of the Italian forces would be the capacity to attack the enemy although diminished by the aforesaid armored cruisers. When, then, the *San Giorgio* division establishes strategical contact, then the main body, on information from it received directly or indirectly, should move against the enemy. In all this the speed assumes decided strategical importance, as it would assume whenever the enemy, owing to our action in the interior basin, must lean for support on one of his principal bases, in such a way as that we may blockade him. A naval force that blockades another in the ways imposed by the present means of war has the greatest interest in arriving in sight of the enemy as quickly as possible; the attainment of its objective is so much the more assured the greater is the speed of the single divisions, which gives us confidence in our ability to impose contact, cut off from their base hostile reconnoitering divisions, etc.

We have enlarged somewhat on the strategic condition of the offensive because there is no doubt of the importance of speed when one is restricted to strategic defense.

The strategic importance of the speed being in general admitted, it is also necessary that our type of vessel have superior maximum speed (an essentially tactical factor); but as in the new French and Austro-Hungarian types there is also an increase of speed over that of preceding types, the problem of maintaining on our part the advantage of speed is more difficult than in the past, less easily reconcilable with the other offensive and defensive requisites that are necessary for our vessel.

Bearing in mind, then, that the attainment of a speed above 20 knots is not irreconcilable with the offensive and defensive requisites that we have deduced, but that nevertheless it constitutes a very difficult problem in engineering, we are constrained to content ourselves with an advantage that, although sensible, does not require too much; consequently, let us establish the speed at 22 knots, because, as we shall see in Chapter II, such speed gives us confidence for tactical undertakings and because it is not difficult to understand that an advantage of two miles in speed may be an indispensable minimum in the strategic field.

In fact the maximum speed that we have already called (as is

the general rule) a tactical factor, because it can only be maintained for a few hours, that is to say, during a combat, may often become a strategical factor in restricted seas. If, for example, we are maintaining a blockade, one of the notable advantages of the blockaded is that of being able to come out at the moment that he may deem opportune, and if he develops the maximum speed it may enable him, we not being ready to do likewise, to gain a sufficient distance for the forcing of the blockade. If the maximum speed that can be developed by our forces were equal to that of the enemy, it might, owing to the initiative that the adversary has in the operation, practically result in less speed; it is indispensable, then, that we have a certain advantage, to the end that in the worst hypothesis we may have equal speed.

The speed that, generally speaking, has strategical importance is that maintainable for a considerable period of time; we may call the *strategic speed* that of three knots below the maximum. The strategic speed of our type of vessel would be (22 knots being the maximum) equal to the maximum speed of the *Danton* type, and a little less than that of the *Radetzky* type. This represents an unquestionable advantage, and it is well to reflect that the common affirmations of the impossibility of maintaining a high speed for long periods can no longer be entertained; it is necessary to remember that high speed, besides being an engineering problem, is a problem of the organization and training of the engine room personnel, and to bear in mind that the English in the grand maneuvers of 1906 have shown that they have fully solved it by obtaining from the ships of the *King Edward* class (of 19 knots maximum speed) a speed of 17 knots maintained from noon of June 28 to the morning of the 30th.

This important result is to be attributed also to mixed combustion; indeed, it is well known that the *New Zealand* that used coal only was obliged to fall behind the other ships.

It would be very practical to use liquid fuel entirely; as Engineer Cuniberti has written, the various kinds of this fuel, being very refractory to any explosion of mines and torpedoes, are useful also from a defensive point of view, since they may be kept in deposits near the keel, forming the new structure for defense against submarine weapons, and from which deposits, with the aid of pumps, it would be easy to transfer it to the various boilers. "But it is a fact that at present there are not yet sufficient de-

posits of petroleum in all the points of supply, and, therefore, mixed combustion is made necessary, still keeping the coal as a defensive reserve. Indeed, a subdivided coal protection near the boilers of every group of turbines may be useful for absorbing at least a part of the energy of the gases due to bursting mines." *

This being so, it is important to determine the requisites to which our ship must answer in regard to fuel supply; it does not seem difficult to establish a standard on the basis of which it could be found in a satisfactory state under the most difficult conditions that can logically be foreseen.

Under the hypothesis of the strategic offensive that we have already set forth, until we succeed in acquiring an opportune temporary base, the main body of our forces would have to be kept cruising. The study of the conduct of our fleet under such conditions being outside the subject, let us limit ourselves to observing that we may meet events with so much greater security if our vessels have requisites that may satisfy even the extreme case that our cruising vessels are obliged to establish refueling turns at a principal base situated at the greatest distance that can logically be foreseen. Naturally, these turns should be established for each strategic unit, because it would be absurd to be simultaneously deprived of vessels of equal type. Granting that we construct four vessels of the new type whose requisites we are studying, their coal supply should satisfy the condition of having only one vessel absent.

The main body of the forces must stand ready to develop the maximum speed, or keep the maximum number of boilers lighted and cruise at reduced speed, so as to have the minimum consumption of fuel. Let us call this the *blockading speed*, to which, by our calculations, there may be assigned (to have safe margin) a mean value of 10 knots.

The run from the main body to the base and return must be made at a speed sufficiently high to meet the interests of haste, but, on the other hand, sufficiently moderate, considering the great consumption of fuel at high speed and the necessity of not excessively exhausting the personnel and materiel. This *passage speed* may be established at 16 knots.

* Cuniberti: "Mines and Turbines," in *Rivista Marittima*, December, 1906.

The vessels' total supply of fuel, then, must be equal to the sum of the following quantities:

1. Quantity C, necessary in order to move at the speed of 10 knots for three times the length of time T that a unit employs in going to the base, refueling, and returning; representing the time necessary for the run, at the rate of 16 knots, from the main body to the base by T_1, and the time necessary for refueling by T_2, we have $T=2T_1+T_2$. 2. A quantity C_2 necessary to move the vessel at 16 knots' speed for the time $2T_1$. 3. A quantity C_3 as reserve for strategic operations, that may be held to be that necessary in order to run about half the distance from the main body to the base at the strategic speed of 19 knots. 4. Reserve C_4 for battle that may be set down as that necessary for six hours' steaming at full power.

Considering the Mediterranean and the various basins that it forms, from the peculiarly Italian point of view, as well as from the more general use of geographico-strategical conditions, we find that, in the said sea, a fleet may be obliged to establish turns at refueling at a principal base at a distance that will presumably fall within 500 miles.

In order to calculate the quantity of fuel with sufficient liberality, let us, then, call the distance from the main body of the fleet to the base 500 miles, which determines C_1, C_2, and C_3; we may besides place $T_2=10$ hours. The value of T becomes 73 hours, hence our vessel must travel:

219	hours	at	10	knots	per	hour.
63	"	"	16	"	"	"
13	"	"	19	"	"	"
6	"	"	22	"	"	"

Being able to say that, roughly speaking, the displacement of our vessel will be about 16,000 tons, we may calculate approximately the indicated horsepower at maximum speed, which gives 24,000, as well as the indicated horsepower for the other speeds under consideration, and deduce the corresponding values of C_1, C_2, C_3, and C_4.

All this admitting as usual: 1. That the indicated horsepower varies as the 2/3 power of the displacement and as the cube of the speed. 2. That the consumption of fuel, taking liberally into

account the auxiliary machinery, etc., may be held to be 0.0012 tons per horsepower-hour. In this way we obtain:

$C_1 = 601$ tons.
$C_2 = 710$ "
$C_3 = 245$ "
$C_4 = 175$ "

Total 1731 tons.

Roughly speaking, we should then have a fuel supply of 1750 tons.

PARTICULARS.

The principal characteristics of the type of vessel that suits us being determined upon, we may say that we have sufficiently developed the first part of the subject, which calls for, not the study of a plan for a vessel, but that of the desirable and possible requisites for our type of battleship.

Before attempting to estimate the necessary displacement, it will be well to make a few brief observations:

1. That the arrangement established for the battery is not in conflict with that of the engines and boilers. Indeed, turbine motors are to be preferred, because—as is said in the English memorandum of constructions for 1906-1907—although they may have at the present time a few inconveniences, they have nevertheless many advantages; among these, there are of the first importance that of the reduction of the number of boilers, and that of permitting the subdivision of the engines, instead of requiring the wide spaces needed for the reciprocating engines.

2. The general aspect that can be imagined for the type of vessel deduced from this study is that shown in Plate II, and is briefly as follows: A forecastle forward with a 305-mm. emplacement, on a lower plane the two central emplacements, and astern, the other heavy caliber emplacement. On the broadsides, with a field of fire ahead and astern obtained by means of hollows in the upper works are the four 152-mm. emplacements.

Between the two central 305-mm. emplacements the field of fire is entirely clear, while between each of these and the corresponding extreme emplacements there is a bridge-house on which are the boats and from each of which rises a funnel, a mast, and a conning-tower.

The masts are naturally tripods, and, as in the *Dreadnought*, they serve as uprights for the derrick booms and support the military tops for fire control, that in this arrangement are inconvenient on account of the near neighborhood of the smokestacks; but it would not be possible to arrange otherwise unless we remove from the longitudinal axis either the funnels or the masts, in which case the field of fire would be obstructed.

We must not enter into a discussion of the details of the conning-tower, but it is necessary to observe that in battle it is necessary to be able to steer by bearings, and hence the helmsman must be able to keep the adversary bearing in the sectors of maximum offense (45° forward and abaft the beam).

Résumé of Requisites. Displacement.—The reply to the first part of the theme may be thus synthetized: The type of vessel best for Italy is one armed with eight guns of 305 mm., eight of 152 mm., twelve of 76 mm.; protected with a large extension of armor having a thickness of 200 mm. to 100 mm., having a maximum speed of 22 knots, with radius of action answering to the most difficult conditions that can be looked for in our seas.

The requisites deduced do not result from the idea of establishing a compromise between the various elements, but from that of obtaining a maximum return from every one; in other words, every one of the requisites demanded for the proposed type is a necessity which we may not remain without. Consequently we may not build a vessel smaller than that which is necessary to unite these requisites, and a larger vessel would constitute a bad use of our financial resources.

Let us now endeavor to estimate what may be about the displacement D of the type proposed.

For the weight Wh of the hull complete with all furnishings and marine fittings we may say, $Wh=0.39D$.

For the weight of the armament, including emplacements, their protection, and the ammunition in the proportions already indicated we have:

For the 305-mm. guns	1881	tons.
" " 152 " "	789	"
" " 76 " "	57	"
Torpedo tubes	20	"
Total	2747	tons.

For the weight of the armor let us observe that in the *Vittorio Emanuele,* deducting the weight of the emplacements, we have for this weight about 3090 tons, and that, reducing the thickness of the armor from 250 mm. to 200 mm., and increasing to 100 mm. her 50-mm. armor, as has been established for the type of vessel under discussion, this weight would be reduced to 3009 tons, the displacement becoming 12,400 tons. Since we may say, roughly speaking, that for equal distribution and thickness the weight of the armor varies proportionally to the 1/3 power of the displacement, we have for the said weight $Wa = 3275$ tons.

For the weight of engines and boilers, since we may call 0.080 ton the weight per indicated horsepower, we have $Wm = 24{,}000 . 0.080 = 1952$ tons.

Finally, from what we have already set forth, the fuel supply may be put down at 1750 tons. The equation of the displacement then is

$$(1 - 0.39)\ D = 2747 + 3275 + 1952 + 1750;$$

from which

$$D = 15{,}950 \text{ tons.}$$

Although this number can only be said to be a rough estimate, it serves to fix the idea, showing how the proposed solution may lend itself to reconciling for Italy the financial exigencies and the new naval exigencies.

The percentage of weights for this type of vessel should be as follows:

Hull and fittings.	Armament. Ammunition. Gun protection.	Protection.	Engines and boilers.	Fuel.
39	17.2	20.5	12.2	10.9

CRITICAL EXAMINATION OF THE CRUISING ORDERS, MANEUVERS, AND FORMATIONS BEST ADAPTED FOR MAKING TACTICAL CONTACT WITH A NAVAL FORCE COMPOSED OF SHIPS OF THE ABOVE SELECTED TYPE, AGAINST A SUPPOSED ADVERSARY OF EQUIVALENT FORCE.

As in the determination of the characteristics of the new type of vessel, so in the study of its tactical employment it is necessary to approximate to reality by studying this employment in relation to probable adversaries and to our fleet already existing; it is, moreover, necessary that we do not limit ourselves to considering the combat as an act in itself, but as a consequence of preliminary acts.

In order to follow these rules, it is best to transport ourselves to a field that, while being general, nevertheless permits of the estimation of the particular values of our new type, examining:

(a) The approach of two hostile naval forces.

(b) The most suitable cruising order in the neighborhood of an enemy.

(c) The formations and the initial maneuvers of battle.

In developing these arguments we have considered the mode of bringing about tactical contact, and we may study the tactical employment, properly so called by considering it under the following subdivisions:

1. Single duel between a vessel of the new type and one of the *Danton* type, or of slightly superior speed. It is obvious that a duel of this kind can very rarely happen, nevertheless the study is very useful because it serves to lead the way to ulterior considerations.

2. Combats between homogeneous groups, considering the types to be as stated above. On this point we may consider that we have developed the proposed theme if we confine ourselves strictly to its statements; but to properly fix the thought upon the tactical aptitudes it is necessary to go a step farther.

3. This step may be made by giving a brief glance at the squadron combat.

Approach.—The typical cases to be considered for the approach may be reduced to two; that is to say, that of the blockade and that of fleets with freedom of movement.

It is evident that the present development of torpedoes will oblige the battleships of a blockading fleet to make short their incursions into the tactical zone of the blockaded place; the blockading force should form a chain, of which the end nearest the port is formed of simple videttes (destroyers), and the outer end of battleships that keep together, cruising or possibly at a temporary base. The links of the chain are groups of vessels; the position and the composition of these groups must conform to two rules.

1. The greater the importance of the vessels the less are they to be exposed to the risks of torpedo attack.

2. Each group is to retire as slowly as possible toward the next outer one, which moves to its support, in such manner as not to lose contact with the main body of the enemy who is seeking to

force the blockade, repelling the secondary forces of the enemy, that are seeking to gain freedom of action for their principal forces.

Reciprocally, the blockaded party, in order to force the blockade, will seek to drive as far off as possible the advanced groups of the enemy, so that its main body may come out unobserved. To accomplish this diversion there is required a group of swift, and at the same time, strong vessels; in short, it is easily understood that such action has the greater probability of success the greater is the force of armored cruisers. In order to render vain the attempts of the enemy in this direction and satisfy the other conditions previously stated, it is necessary, on the part of the blockaders, that the penultimate link of the chain that begins with the videttes and has its head in the main body, may be made up of armored cruisers. If the blockaders have at their disposal battleships of high speed, such as those of the type described in Chapter I, such ships can render efficient service, since they can, more quickly than others, support the armored cruisers and prevent the diversion attempted by the enemy; but it is very important to note that vessels of this class, if they constitute the most important units of the fleet, cannot be kept in advance of the main body without exposing them to risks that their importance makes it necessary to avoid. These vessels, then, may support the armored cruisers at need, but only up to a certain point, it being necessary for them to remain within the limits laid down for battleships.

Analogously it may be said in the case of squadrons that, besides the strategic scouting, having for its object to keep the enemy in sight, they perform tactical scouting, meaning by this term, the scouting about a main body of vessels with the object of spying out the enemy's movements and covering our own; it is only necessary to mention that the forces destined for tactical scouting, in order to satisfy the requirements of the case, should be able to fight the tactical and strategical scouts of the enemy, as well as to return in time to their group leaders and to the main body for partial and general tactical actions.

This requires that the tactical scouts be disposed in such fashion that those farthest from the main body may be those of minor intrinsic tactical value and greater speed.

This being said, it may be useful to introduce a description

that, although it may seem fantastic at first sight, will serve to fix the ideas upon the manner in which we may imagine to ourselves that the encounter of two squadrons surrounded by tactical scouts may take place. A scout of the outer line has seen a suspected vessel; moves to recognize it and, by means of the wireless telegraph, informs the nearest friendly vessel which in turn transmits the news to the commander-in-chief. Also the suspected vessel has headed toward our scout so that the recognition is quickly made; the vessel sighted is a protected cruiser of the enemy, weaker than ours, and that consequently, at a distance of not less than 7000 meters, turns to run. The commander-in-chief does not consider this to be of sufficient importance to change the course of the main body. The chase of the two cruisers continues for some time, and ours gains upon the adversary, so that there is hope of making a good stroke. Even a few shots which do not hit the mark are exchanged by the two parties when other suspected ships are seen on the horizon, and very soon they are discovered to be enemies. It is now time for our cruiser to show her heels; it is well to state, however, that while our vessel was getting farther away from our naval force (following the chase) another vessel was moving in such position as to be able to maintain with her the chain for the transmission of news. When the new hostile vessels are signaled a division of our own protected cruisers is already concentrating in the direction of the enemy; we have again the preponderance of forces and again the enemy withdraws. The course of the main body is somewhat inclined in that direction and the appearance on the horizon of the additional vessels decides us to effect a reconnaissance, that is, to ascertain if the principal forces of the enemy are more in number than those sighted. To this end it is determined to send toward the enemy a force that will not be obliged to retreat except before his main body; in other words, the armored cruisers are sent this time and the battleships follow at a distance ready to support them. The appearance on the horizon of a new hostile division further confirms the idea that an important force is to be found in that direction, and indeed in the new division we soon recognize the enemy's armored cruisers. The inferiority of the enemy in vessels of this type is not slow in producing its effect; the adversary, in order not to be beaten in detail, must retreat and seek the protection of his battleships that are sighted soon after. The object

of the reconnaissance is attained; our vessels take up a course parallel to that of the enemy, at his speed, and signal to the commander-in-chief the composition and formation of the hostile force; our admiral is now in condition to arrange his forces for attacking the enemy in the most opportune manner, or to reverse his course if he does not wish to accept battle.

What has thus far been set forth concerning the approach of two fleets shows us that we must abandon the idea of having a type of vessels that answers at the same time to the requirements of a battleship and of an armored cruiser. The requisites of the battleships must be determined, as has been done in this study, on the basis of securing the maximum return from the various elements of power; the characteristics of the armored cruiser must then fall below those of the battleship, utilizing a reduction of protection and of armament to secure speed. The characteristics of our battleship closely approach those of the latest English cruisers of the *Invincible* type; but the question is a relative one because the terms, armored vessel, and armored cruiser, are far from having an absolute signification; it may very well be said that the characteristics of the type of battleship best adapted to the needs of one nation, may approach those of the type of armored cruiser best adapted to some other nation.

However, it clearly follows that the battleship and the armored cruiser answer to different necessities, and that a nation may abstain from constructing vessels of the latter type only when its possible adversaries do the same.

Cruising Formation.—The extension of the explored zone that could be obtained by extending also the battleships in chain as well as the cruisers may seem opportune when our vessels possess a speed superior to that of similar enemies, so as to be able to effect a concentration in good time; it must be avoided, however, when one occupies a central position between hostile divisions, because the English maneuvers of 1906 have very well shown the dangers to be encountered in this way. Also if the enemy can come from one direction only, it is necessary to resort to such a system when there exists the possibility that the assembly of our battleships may be delayed owing to the configuration of the coast. As an elementary measure of prudence, the general principle may be established that the battleships should cruise together and that the armored cruisers should be easily able to assemble on them.

The cruising formation of the battleships should naturally be determined by the possibility of torpedo attack and of tactical contact with battleships.

The vessels, by day as well as by night, may trouble themselves less about torpedo attacks according as their speed is greater; the reasons are: 1. The difficulty of estimating the speed of a vessel, already mentioned. 2. With the said speed there increases for the torpedo-boats the difficulty of reaching a position for launching the torpedo; this, for a torpedo-boat, depends upon the time necessary for reaching this position, keeping as long as possible beyond the radius of action of the light artillery; a submersible that sights a ship may submerge herself and approach protected by her invisibility, but her inferiority in speed with respect to her target hinders her doing this over a portion of the horizon that is greater according as her inferiority is greater.

A first defense against torpedo-boats is constituted by the tactical scouts; moreover, it is necessary to add destroyers to these scouts, and it is also necessary that other torpedo-boats be kept in close proximity to the main body in a way which we will now specify. This with the following objects:

(a) To oppose the hostile destroyers and torpedo-boats that may attempt to approach the main body.

(b) To signal the submersibles in time so that the ships may maneuver accordingly. In fact, in order to attack, the submersibles should submerge themselves at a distance of from three to five miles from the target, steering to meet it, correcting the course by means of the periscope, finally to place herself with the bow in the proper direction and launch the torpedo. If a submersible is signaled at the aforesaid distance, in order that she may not be able to reach a launching position, it is sufficient that the ship alter her course by an angle of about 40° for a moderate speed for the vessel and the maximum speed for the submersible (speed of the ship 12 knots, of the submerged submersible 8 knots, of the torpedo 24 knots over a run of 1000 meters).

The rules for the employment of the torpedo-boats for the protection of the main body of the force are then as follows:

By Night.—Remembering that the torpedo vessels that come up from astern are the least dangerous, it is necessary that the naval force be preceded and flanked by groups of torpedo vessels, at such distance from the main body that the ships may use their

search-lights at need without fear of illuminating them. Each of these groups should cruise in compact formation in order to be ready to attack the enemy's ships that it may meet. The utilization of the greatest cruising speed may be obtained by making these groups run in zigzags with their sides conveniently inclined to the course of the main body. These torpedo vessels should signal the enemy's torpedo vessels and endeavor to repel them without approaching within the range of the light artillery of their own ships since all the ships should be able to fire against any torpedo-boats that may approach them.

By Day.—In order to exercise vigilance against submersibles it is necessary that the destroyers keeping watch ahead and on the flanks be distended in chain; it is desirable to have a chain at three miles and one at five.

For the cruising formation of the vessels composing the main body of the force:

By Night.—Remember that the maneuvering of the hostile torpedo vessels will be intended to execute the attack while remaining as little as possible exposed to fire; for this purpose every torpedo vessel will attack the first ship, and only when they deem her to be disabled will they launch against the next one. It is best, then, for the ships of the main body to cruise normally in line ahead (column of vessels) with the following advantages:

1. To torpedo vessels sighted ahead there is offered a smaller target and the vessels can fire ahead by drawing out of the line ahead and to the opportune side as fast as may be necessary.

2. With torpedo vessels sighted abeam the maximum defense can be utilized.

3. The (attacking) torpedo-boats are placed under the worst conditions for retiring after launching their torpedoes.

4. The formation is easily manageable for successive changes of direction, signaling the amount of change with the stern light.

When the number of the ships is considerable it is better to use the formation in columns, with such interval between the columns as will permit the free use in action of the light guns and the search-lights. (The search-lights will be used only when the presence of hostile torpedo vessels has already been signaled.)

By Day.—The most suitable formation is, as is well known, that of line ahead if there are few ships, and in columns abreast if the naval force is numerous. Being able to maneuver in time to pre-

vent hostile torpedo-boats of any class from passing between the columns, and being obliged, for reasons already pointed out, to keep the main body of the force compact, the interval between the columns may be kept equal to the open order interval (between vessels?), thus obtaining sufficient freedom of movement for unforeseen cases. The vessels that compose each one of the columns should be selected according to the idea of homogeneity, this being an elementary tactical necessity. Thus far we have turned our attention to logistic requirements; let us now examine into the best way in which a naval force may arrive in sight of an enemy.

Initial Battle Formations and Maneuvers.—If our cruisers have repulsed those of the enemy and have come into contact with the enemy's main body, in such fashion as to be able to give information concerning his movements, we have the singular advantage of regulating our movements by those of the enemy without his being able to do the same. The complete attainment of such a desideratum would require that the cruisers and the main body be in constant radiotelegraphic communication. This ideal will not always be reached because the enemy will seek to disturb our communications; it will, therefore, be necessary that the main body and the divisions in contact with the enemy be connected by a chain of light vessels for the transmission of news by wireless or by ordinary signals. On the basis of the information transmitted to it, the main body prepares itself for battle, so as to arrive in sight of the enemy in advantageous formation and position.

The benefit of seeking, out of sight of the enemy, an advantageous position comes from the fact that the more the distance of sighting, or, better, the distance at which the enemy can take account of our formation, is greater than that at which firing may be commenced, the more it is possible that at least a part of the initial advantage may be preserved up to the firing distance; such benefit will be all the greater the more the firing distance increases, approximating to the distance at which exact account may be taken of the adversary's formation.

The fundamental conceptions that should jointly inspire the tactical maneuvers, as well at the beginning as during their development, are the following:

1. To bring into action the maximum number of guns.
2. To have an advantageous tactical position.

The types of advantageous position may be reduced to two,* that is to say, putting a part of the enemy's forces under conditions of not being able to fire, or such that their fire may be less effective because executed at a greater distance than ours. The first object is satisfied by the T positions, the second by positions equidistant from the nearest part of the enemy's line, as shown in Figs. 2 and 3, in which, for simplicity's sake, the arrangements are represented by simple lines.

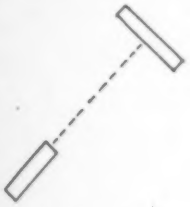

Fig 2

Fig 3

Equidistant positions bring, at the fighting distances and with numerous forces, a slightly curvilinear arrangement. Let us remark, however, that seeking to take an advantageous tactical position out of sight of the enemy, owing to the great length of the radius, the arc of the circle is indistinguishable from a right line, and hence the types just mentioned amount to arranging one's forces on a line of bearing normal to the nearest part of the adversary's force.

This being established, the party that is not in condition to drive back the hostile cruisers and thus cover its own movements, will seek to arrange itself on a line of bearing as near as possible to that normal. For this purpose, from information obtained from one's own cruisers, that will at least have had a fleeting glimpse of the enemy's main body, from the position of the latter's cruisers, as well as from the configuration of the coast, it will be possible to establish approximately the direction in which the principal hostile forces are to be found. For this party, the proper

*A tactical position should also be considered advantageous when it is the result of natural elements (direction of wind, and of the sun, visibility of our vessel). But it is easy to convince ourselves that these elements are of secondary importance compared with the two types of position above indicated.

direction for the line will be determined in some such way; the course will generally depend upon strategic exigencies.

For the other party we may distinguish two cases, according as he may or may not find himself on the prolongation of the enemy's line.

Let us remember that for every tactical maneuver there exists a fitting counter-maneuver sufficient to render it futile; but even a slight delay in making the necessary response to the enemy's movement may establish conditions of inferiority with rapid results.

Let us now consider two hostile assemblages, each of which is drawn up in the direction of the line joining them, or in a line that is slightly deflected from it. Of these two parties, the one that at a certain moment rapidly changes direction will succeed in crossing the T, if the enemy delays to arrange himself in parallel fashion. This delay, which means a smaller number of guns brought into action, may depend upon delay in arriving at a knowledge of the enemy's maneuver, upon inferior speed, upon having the means of offense scattered over a larger number of vessels, or, finally, upon a formation that does not permit the rapid execution of the movement that would be necessary.

In the first of the cases before mentioned the party A, when his forces in contact with the enemy signal to him that the enemy B is drawn up in the direction of the joining line AB, could himself also approach in like array, with great probability of advantage on his part, when his speed is superior to that of B, and when each single vessel, contrasted with the hostile units, has a greater number of guns of the maximum caliber, which are those most effective at the great distances at which the action is begun.

An assemblage of vessels of the type considered in Chapter I would have the advantage in approaching in this guise a hostile force composed of ships of the *Radetzky* and *Danton* types; it would, therefore, be more prudent for the latter to renounce keeping the enemy to the last uncertain as to the maneuver that he intends to make, assuming a formation normal to the joining line AB.

When the enemy's line departs considerably from the aforesaid joining line it will generally be best for the force A to maneuver so as to bring about the arrival in sight in a position as near as possible to a direction of minimum offense of the hostile assem-

blage. This is satisfied by successive changes of direction in line ahead, successively altering the course so as to keep it normal to the line joining him with the enemy.

That fleet that on sighting the enemy recognizes that it has the advantage of position and of formation will seek to change the distance as rapidly as possible in order to arrive in like condition at the distance for opening fire, or it will run at maximum speed.

The other fleet will seek to gain time for executing the necessary conversion of the line, and when it recognizes that its initial position is too much inferior, it will execute such conversion while retiring, unless it is hindered from so doing by local conditions.

The Duel.—In order to follow the line laid down in the beginning of the chapter, let us suppose that a vessel of the proposed type finds itself about to fight against a ship of the *Danton* type.

Our ship, which we will designate by *I*, has considerable superiority in bow and stern fire, having six 305-mm. and four 152-mm. guns, against two 305-mm. and four 240-mm. guns. If *I*, at the maximum distance at which the firing may be considered effective, keeps *N* bearing directly astern and keeps the same speed, the opposing ship, unless it wishes to drop out of range, must fight with *I* bearing directly ahead, thus placing herself in a condition of inferiority. Our vessel, owing to its greater speed and armament, may then: 1st, decline tactical action; 2d, put the enemy to the alternative of not being able to fight or of being obliged to fight end on.

If, however, *I* desires to fight at any cost and executes the above-mentioned maneuver, then *N*, bearing from *I* in a sector of maximum offense, will be obliged to do the same; the duel will then be developed with the adversaries bearing from each other in the sectors of 45° forward and abaft the beam.

If the vessel *N* has good reason for declining to fight, and on this account brings *I* to bear directly astern, our vessel will be in a situation to impose action in a way very advantageous to her, because she could alternately bring the enemy to bear ahead, and in a sector of maximum offense, as we have already pointed out in Chapter I.

Rather than remain in this disadvantageous situation arising from her inferiority in speed and in end-on fire, it would be better for the vessel *N* resolutely to accept the battle by bringing *I* to bear in a broadside sector.

Let us then examine the general case of the two supposed adversaries fighting and firing with the maximum number of guns. It is easily seen that all the directions included in the sectors of maximum offense are alike, in so far as regards the probability of the vessel's being hit. Indeed, the doubt may arise that owing to the facilities for the observation of the lateral misses, a vessel may have a smaller probability (of being hit) by presenting the beam; but this doubt disappears if the question is studied in concrete fashion. Our vessel necessarily having about 150 meters length and 25 meters beam, the difference between the depth of the supposed thin horizontal target on a bearing of 45°, and that when presenting the beam, is less than 10 meters. (It is exactly 9.75 meters when the horizontal section of the vessel is considered as an ellipse); hence it is negligible, the more so that in practice the lateral misses, although easily observable, will not be completely eliminated, and at 45° there will be a smaller lateral probability that will compensate for the small increase in the depth of the target.

The conditions in regard to the probability of being hit being thus defined, it is clear that the bearing on which it is better to keep the enemy in order to reconcile the offensive and defensive requirements is 45° forward or abaft the beam, or slightly less.

In order to establish rules for tactical maneuvers it is necessary to examine the question of the fighting distance.

The convenience of keeping oneself inclined to the line of fire being in general admitted, we may not determine the most convenient distance on the basis of the perforations at an angle of impact of 90°; we are not even able to find the solution in the difference that exists between the two adversaries in the total energy developed by the projectiles on striking, because it is clear that the dynams (dinamodi) corresponding to a gun of 152 mm., or of 240 mm., are not to be compared with those of one of 305 mm., otherwise we should end by admitting that a certain number of guns of 37 mm. might be equivalent to one of 305 mm.

As we have already had occasion to point out, the question to which we now address ourselves is put upon a practical plane by our proposing to seek out, not a determined and fixed value for the distance, but the limits between which it is well that the distance be included.

The rules which we are seeking should tell us only if it is better

to fight at between 3000 and 5000 meters, or between 5000 and 7000 meters.

The elements to be considered are: The strategic situation, the differences in the percentage of effective hits, in the armament and in the protection.

It is evident that the more the action becomes decisive the injuries that we inflict upon the enemy increase, but our own injuries increase at the same time; it is then a question of determining whether the difference does or does not result to our advantage. The application of the Nelsonian principle of annihilation is not always permitted by the strategic position; it is not necessary to restrict the view to the field of battle, but rather to look beyond the victory of the moment to triumph in the war. When the radius of action of weapons was very limited, looking to a relative safety was synonymous with ineffectual battle, but in the present state of things the struggle at long range is not any more ineffectual if the battle is limited to it than if it contemplates a struggle at a lesser distance. The principle is thus established that the greater the importance of the conservation of forces in view of the strategic situation, the more profitable is the long range action. Naturally the just appreciation of the situation can only be made in the concrete case and not in a general study like this; we may remark, however, that when we are engaged in a struggle with a weaker navy, we shall have less interest than the enemy in the conservation of forces; but this would not signify the necessity, from the outset, of closing the distance.

The difference in the percentage of effective hits, the number and class of guns being equal, may depend upon various causes, as, for instance, a difference in the ability of the gun-pointers, in the efficiency of the mechanism for gun laying and for the measure of distances, etc. In a word, the difference evidently varies with the firing distance; it is clear that at short distances even a mediocre gun-layer fires very well, while the difference in ability is always more to be noted when the distance increases and is so much the more apparent if the vessel is subject to rolling and pitching motion.

Whoever at any moment keeps his own percentage of effective hits greater than that of the enemy should remember that such difference between percentages tends to increase, because it produces injuries and disorder.

The difference in armament may be considered from the point of view of the number and class of the weapons. With equality in class of weapons, the effect of a quantitative superiority is the more felt, the more the distance diminishes; the exponent of the advantage that the most numerous combatant obtains in diminishing the distance is evidently represented by the probability of hitting multiplied by the difference (in number) of the guns of the class considered.

But this diminution of distance has a limit depending upon the class of the weapon in which the advantage lies, and it may even be reduced to zero; such is exactly our case, because, while against a vessel armed with four heavy guns and a numerous battery of medium caliber, the rule just laid down would bring our type of vessel in the neighborhood of the lower limit of the long distance, on the other hand, with a ship of the *Danton* type, it must be said that, still, the 240-mm. guns are long range weapons, and that consequently for our type the maximum distance is advantageous, at least at the beginning of the action.

In regard to differences in protection we know that the maximum thickness of the armor in the *Danton* type is 25 cm., and, even if it were somewhat greater, the protection in our type of vessel would always be equivalent thereto by virtue of an opportune inclination (to the line of fire), with the advantage of a greater extent of protected surface.

On the whole we see that with our type of vessel it is better to keep the distance near the maximum; the progress of the action and the strategic situation may render it advisable to follow the initial phase with another at a shorter distance. The long range is better, even in the case that our vessel must, for fleeting instants, present her beam, because of the greater perforating power of the 305-mm. guns.

To illustrate, let us admit that our vessel determines to keep the distance between 5000 and 7000 meters; although there may not be established a fixed value for the distance, there exist reasons owing to which it is generally advisable to keep constant some value of the distance included between said limits.

Since the danger space diminishes as the distance increases, at long distances it becomes necessary to follow the distance very exactly with the sights, much more so than it would be necessary to do at medium distances; it is, therefore, indispensable to keep

the distance nearly constant when one has more interest than the enemy in making this phase of the combat effective.

But if the enemy should present his broadside, our vessel should also do the same, if it is desired to keep the distance constant; it will hence be necessary for us to content ourselves with keeping it within the desired limits by bringing the enemy to bear alternately 45° forward of, and 45° abaft the beam. The decrease in the efficacy of the action on account of the variableness of the distance will be compensated for by the possibility of perforating the enemy's armor, while our vessel will only present the broadside at the instant of passing from the bearing forward of the beam to that abaft, and *vice versa*.

In substance the maneuvering of our vessel in the duel is the following:

We have a horizontal circle on which are marked the fields of fire of the guns, and about its center revolves an alidade for steering by the sight vane. It is established that the speed is not to be allowed to fall below a certain value, for example, 15 knots.

Let us suppose that the enemy has us bearing forward of the beam; we commence steering with the sight vane at the angle 45° abaft the beam, at maximum speed; if we perceive that the distance is increasing, we have the angle of the sight vane unchanged and lessen the speed little by little until we reach a value at which the distance remains constant; if at the speed of 15 knots the distance continues to increase, we bring the enemy to bear little by little toward the beam; arrived at a certain angle of the sight vane, 35° for example, it is well not to approach the beam further but to allow the distance to increase up to the highest limit established and then pass to the angle with the sight vane 45° forward of the beam, and so on. We maneuver analogously if the enemy has us bearing abaft the beam.

It is to be noted that our vessel (by virtue of her superior speed) would be mistress of the maneuver even if the sectors of maximum offense were extended to 51° from the beam in the *Radetzky* and to 55° on the *Danton*.

Battle between Homogeneous Groups.—The maneuvers pointed out for the fuel debar our vessel from seeking to pass the enemy on an opposite or parallel course; aside from everything else, it is sufficient for the exclusion of this maneuver to observe that at any one instant the bearings of the combatants from each

other would be exactly the same, but from this the enemy's vessel would be able to draw the greater advantage, having plates more resistant than ours, owing to the fact that our ship had abandoned maneuvering on the bearing which permitted her to compensate for the greater vulnerability of her armor.

The same thing may be said of the case in which a group of vessels of the proposed type is engaged in a struggle with vessels of the foreign types considered. With the same formation, passing in opposite directions is more profitable for the ships that have the heaviest plating, and naturally it would best suit that party to facilitate our falling into that error, the more so that it is in our power to avoid it. If other conditions do not prevent, it forces the enemy to fight forward of the beam.

It is well to note, however, that passing in opposite directions with our ships in single column can be advantageous whenever the enemy keeps a formation other than that of single column, essentially because, with the continual change in the bearings, our vessels will be for some moments in the directions of minimum offense of the enemy as a whole; in so passing we shall naturally seek to form a T across the enemy's rear.

The simplest idea would be that of maneuvering our vessels in single column in succession, while the leading vessel would maneuver as in the duel with respect to the nearest vessel of the enemy; but it is easily understood that aside from the advantage of keeping the distance within the desired limits, such maneuvering would not generally represent the best utilization of the qualities of our vessels.

Nevertheless we remark, without need of recourse to a minute analysis, that maneuvering in column, in succession, that has the great value of facility of execution, is to be recommended when the enemy keeps unaltered the magnetic bearings between his own vessels, or keeps on a constant course for a considerable time. The single column then lends itself in the best way to the securing of positions for crossing the T, or of positions equidistant from the nearest part of the enemy's line.

Thus, for example, the maneuver for forming the T should evidently consist of the following two successive parts:

1. To bring ourselves in a direction of minimum offense of the enemy.

2. To place ourselves on a line of bearing normal to a line

joining a part of our own formation with the nearest part of that of the enemy.

We may not overlook the offensive and defensive situation of the group in the first phase of the maneuver, and it is desirable that on arriving in the direction of the enemy's minimum offense, the group may find itself already formed on the normal line of bearing. To this, owing to its flexibility, the maneuver in succession in single column lends itself very well, and we may hold, therefore, that in the generality of cases it will be preferable to the other of moving on a line of bearing (bow and quarter line) and executing afterwards a rotation of the line.

For the equidistant positions, the already mentioned drawing of White of the battle of Tsushima, in the part regarding the movements during the first hour, illustrates the efficiency of the single column against an enemy that obstinately keeps to the same formation with a constant course. As that may be attributed to the very considerable difference of speed that existed between the adversaries, we have designed Fig. 1 of Plate III that refers to a hypothetical case in which 10 vessels of our type with a speed of 22 knots make against 10 hostile vessels moving at 20 knots, a maneuver analogous to that which, according to White, was made by the Japanese. The distance between ships is, for both parties, 300 meters.

The admiral of the speediest party, who has the head of the line, before arriving at the firing distance steers as if he wished to pass on an opposite course, and in such fashion that his own vessels are about at the same distance from the head of the enemy. Before entering the sector of maximum offense of the head of the hostile column (45°) he quickly changes direction followed by the other vessels, bringing the head of the enemy's column to bear 45° from the stern, and for a certain time he keeps that bearing constant. The tactical situation of the slower party continually becomes worse, so much so that after 20 minutes the head of our column may, without inconvenience, diminish the angle of the sight vane from the beam in order to dispose his vessels in positions about equidistant from the head of the enemy. If we consider the positions after 25 minutes of firing we find that the difference between the distances at which the swiftest vessels execute the firing (they all fire with the maximum number of guns, naturally concentrating their fire upon the head of the enemy's

column) is 600 meters (5200−4600), while for the ships of the enemy (which concentrate their fire upon the rear of our line) the corresponding difference is 2100 meters (6700−4600), with the disadvantage of not firing in a sector of maximum offense.

If this leads to the admission that even an advantage of two knots' speed may be sufficient to give the advantages that Togo obtained at Tsushima, it is nevertheless not enough to authorize generalizations. The hypothesis that the enemy may maintain a passive attitude similar to that which we have just supposed is not to be excluded, because when the fire is concentrated on the ship that leads the enemy's line, we may hope that by putting the said ship out of action, the case of a line without a head will be repeated, as was the case in the battle of August 10 and at Tsushima, but that does not remove the possibility of a very particular hypothesis, and it is best to supply rules on the general hypothesis that the enemy may maneuver so as to utilize well all his forces.

With this object we observe that, since we are considering a combat between homogeneous groups, the hypothesis of a combat of 10 vessels of our type with 10 of the enemy's is an abstract one; of the said vessels we can put in construction four, while France is constructing six *Dantons* and Austria three *Radetzkys*. The vessels that we may afterwards construct will differ from these, and in their employment with existing ships they will enter the field as heterogeneous groups.

It is then practical to suppose that four vessels of the proposed type may be found fighting against four or six units of a comparable type.

The rules for the maneuvering of said group should be general like those for the duel, that is to say, not limited to a particular hypothesis. Let us bear in mind the objectives to which we must look, classifying them in the order of their importance:

1. All the vessels should be able to fire with the maximum number of guns at the enemy's vessel upon which it may be opportune to concentrate the fire.

2. Seek to occupy positions equidistant from the said enemy's vessel upon which fire is concentrated.

3. The utilization of the group will be greater the greater the tactical return of each unit, that is to say, the more the maneuvers of each and every vessel with respect to the enemy's vessel, on which the fire is concentrated, approximate to those of

the duel, that is, convenient inclination (to the line of fire), and a distance constant or slowly variable.

The same rules laid down with respect to the duel concerning the most convenient distance can evidently be extended to the case of homogeneous groups, and they establish for our group the convenience of fighting at long range, and so bringing it about that the distance may be nearly constant; but precisely as in the duel we must not be fast bound to maintaining the distance constant at any cost, but allow it to vary, if necessary, between the most opportune limits. Thus, for example, supposing the two hostile groups in single column, the head of the column of the slower group, by keeping the head of column of the other group abeam, obliges him to present the beam in his turn if he wishes to keep the distance constant. The tracks of the two adversaries will in this way result in concentric circles; at short distances, the curvature of the trajectories would cause the rear vessels of the slower group to have their fire masked by those ahead of it, but this would not happen at long range. Under such conditions the swifter group would have no sensible advantage; it would then be well for it to give up the constant distance to obtain the advantage of a better inclination to the line of fire.

The objectives being established as aforesaid, the rules for maneuvering follow as a direct and logical sequence, taking count of the following axioms:

1. After having excluded the notion that maneuvering in single column can satisfy any case whatever, we ought not to bind ourselves to maneuvering on a line of bearing, to be changed from time to time. In fact it is true that for every tactical situation there exists a line of bearing that answers the purpose, but the time necessary for passing from one line to another is very considerable, even with a limited number of ships, so as to render it impossible to foresee the tactical situation at the end of the maneuver with sufficient exactness.

2. With a group composed of a limited number of vessels, such as we are now considering, the possibility of allowing each and every vessel a certain liberty of movement is understood, thus obtaining that the formation is continually changed, in the opportune way, by adapting itself at every instant to the movements of the enemy.

This being granted, the general rules that we are seeking are the following:

(a) The vessel that regulates the movements of the group will at all times maneuver with respect to the nearest enemy's vessel, or more generally, in respect to an extreme vessel of the enemy's formation (care must be taken to indicate this vessel to the other ships), as he would do in the duel, at a distance constant or variable according to the cases already considered.

(b) The regulating vessel of the group is the inside one on the side of the changes of direction necessary for steering by sight-vane.

(c) Each of the other vessels of the group, besides following in the water of the regulating ship, should edge off parallel to it, regulating the speed so as to bring it about on the arc of a circle that passes through the regulating vessel and has for its center the enemy's vessel upon which the fire is being concentrated, or in the position nearest to that circle that permits of keeping the aforesaid enemy's vessel in a sector of maximum offense. A vessel can generally be considered in the best position when the angle between the line joining the next friendly vessel to the regulator and the line joining the said vessel with the enemy's vessel (the target) is about 90°.

It is well known that this produces no danger of collisions, because the courses of two adjoining vessels are either parallel or slightly divergent, the changes of direction are not simultaneous but successive at very short intervals, as rightly should be the case. With this maneuvering, the intervals between vessels of the same group will undergo alterations, but keeping it opportunely in mind in changing the direction, it will be possible to render the effects negligible; in practice the formation will not be exactly on the arc of a circle, but it will approximate to it sufficiently to produce a good tactical situation.

As an application, Plate IV may be considered. It is supposed that the enemy maneuvers in single column; his leader N_1 has our ship I_1 (which is the nearest) bearing 45° forward of the beam, because he judges that in that way the following vessels may also be in conditions to have I_1 in a sector of maximum offense. The intervals between vessels are for both parties established at 300 meters. The ship I_1 desires to fight at 6500 meters; it is supposed that he is fighting the starboard side the same as the enemy. Ac-

cording to the rules for the duel, the vessel I_1 steers by sight-vane on the bearing 45° abaft the beam, slackens the speed until he finds that the distance remains constant, and as the sight-vane angles are equal the speed determined in this way by I_1 is the same as that of the N ships, so that the ship I_1, as well as the N ships, is moving on the same circle with a radius of 4600 meters. The ships I_2, I_3, I_4, moving according to the rules laid down, that is to say, keeping the distance from N_1 at 6500 meters, ought to trace circumferences with radii greater than 4600 meters, and hence there is necessary for them a greater speed than that of the enemy and of the regulator I_1. As the relations between the speeds should naturally be equal to those between the radii of the concentric circles the necessary speed of the ship I_4, which is the outer vessel, is 22 knots if the speed of the N ships is 19.5 knots. Each one of the I ships in this way has N_1 bearing in a direction that is practically 45° from the beam. The vessels following N_1 have the vessel I_1 bearing at angles from the beam considerably less than 45° (for N_6 the angle is 35°).

The rear vessel of the N group is then 7150 meters or 7400 meters distant from I_1, according as the vessels number four or six. The differences 650 meters and 900 meters in the firing distances of the N vessels give to the I party a sensible advantage.

The observation that naturally arises is that the N vessels may place themselves on a circumference with a radius of 6500 meters and a center at I_1 and trace circumferences concentric with that of N_1 at lower speed, keeping I_1 bearing 45° from the beam. In this way the party N would be in a situation perfectly identical with that of the I party.

But it may be considered that in this way the regulating ship of the N party would be the outer one on the side of the changes of direction, at least until the arrival of the vessels N_1, N_2 . . . . N_6 on the circumference with center at I_1; hence the maneuver does not present the same guarantees of safety for the party N as for the speedier party.

In order to have the same guarantees the N ships should deploy outside of the circle of N_1, which would necessitate a slacking of the speed of the regulating vessel; but clearly this maneuver would be absurd because during it the N vessels would mask each other.

BATTLE OF SQUADRONS.

Let us suppose that the main part of a naval force A maneuvers together against that of an adversary who divides his force into two groups B' and B''. The force A succeeds in getting into the interval between B' and B''; if it has a speed superior to that of the slower of the enemy's groups, which we will suppose to be B'', the B party will be in a very disadvantageous position if A steers against B'. Indeed under such conditions B' can either keep its distance or steer against A. In the first hypothesis the distance from A to B'' will constantly increase; in the second the forces A and B' will pass each other on opposite courses, but B'' will have no part in the action.

We have, then, a particular case in which the interposition between the enemy's forces permits of fighting with a united force against a part of the enemy's force. An examination of this case brings us to conclude:

1. The maneuver of separating the enemy is one that may advantageously be attempted by a compact naval force maneuvering against an adversary divided into groups, when the compact force possesses a speed superior to that of the slower of the enemy's groups.

2. A necessary condition in order that a naval force may fight maneuvering in groups is that each group shall possess equal or superior speed to that of the united enemy.

Italy always having taken care to obtain in her battleships a speed sensibly superior (and in any case not inferior) to that of contemporary ships of other nations, it is presumable that a hostile squadron could be constrained to keep his principal forces united in the presence of our own which would be able to maneuver divided into convenient groups.

The study of the battle of squadrons does not enter into the limits of this work; in order to restrict ourselves to indicating the return that we may expect from a group of vessels of the proposed type, it is sufficient to observe that battleships of high speed (such as those of the *Vittorio Emanuele* type and as would be those of the proposed type) will command an advantage in speed that will be the difference, not between their speed and that of the most recent vessels, but between their speed and that of the enemy's slowest type.

Under such conditions the new vessels will have an advantage

in speed that it is not rash to place at about six knots, and this advantage will permit them, maneuvering generally in single column, to place themselves in directions of minimum offense of the total force of the enemy.

In conclusion the type of vessel that in our *poor weak way* we have endeavored to set forth answers to the same fundamental conceptions from which has already resulted the Bettolo-Cuniberti plan of a vessel of 8000 tons, and that has produced the ships of the *Vittorio Emanuele* type, with the addition of the high importance to be attributed to guns of a greater caliber. A group of these ships, with their high speed, with their heavy guns, in virtue of a good preparation of the personnel, will permit us to bring into action, from the beginning of the battle, from the maximum distance, that intense and powerful fire that will produce the first turning of the scale. This type is based upon the golden Napoleonic maxim *frappez fort et vite*, that has been so well applied by the Japanese, and upon which there is to be formed a truly modern system of strategy and tactics.

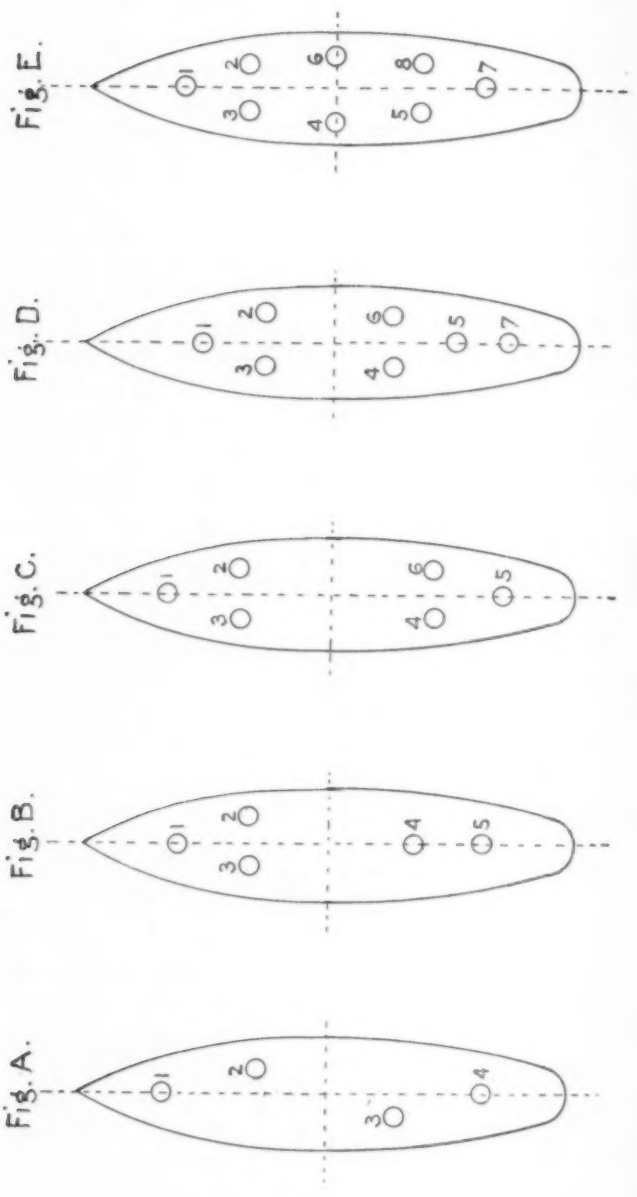

PLATE I.

DISTRIBUTION AND NUMBER OF THE TURRETS FOR HEAVY GUNS.

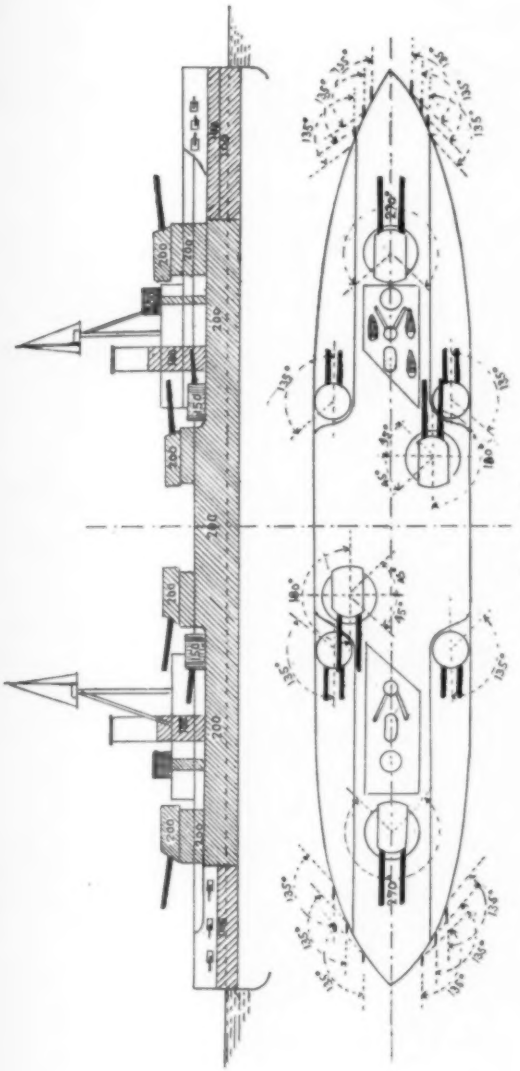

PLATE II.

A SKETCH OF THE PROPOSED TYPE OF VESSEL.

PLATE I.

DISTRIBUTION AND NUMBER OF THE TURRETS FOR HEAVY GUNS.

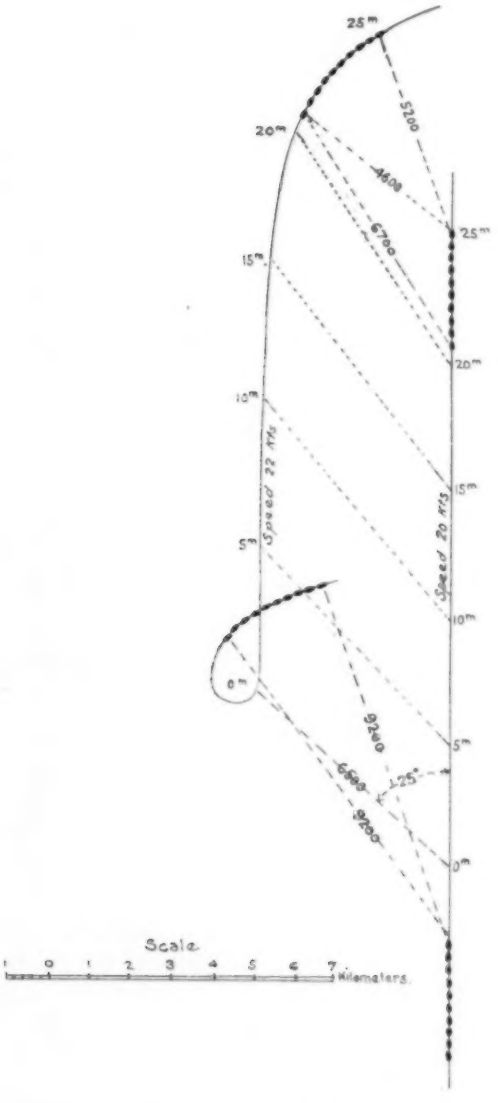

PLATE III.

MANEUVER IN SINGLE COLUMN.

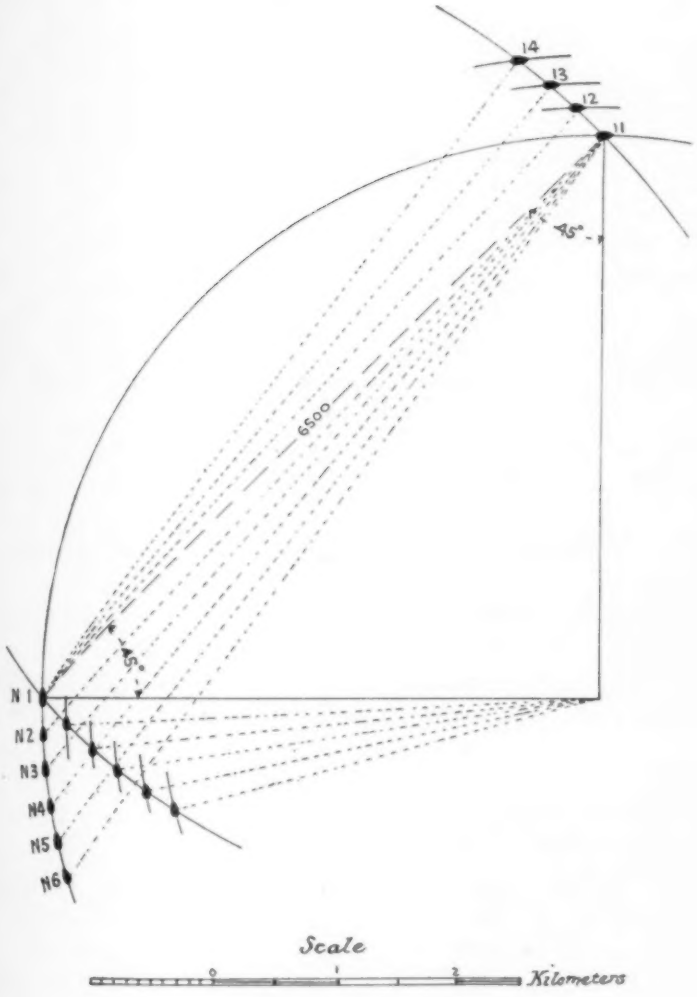

PLATE IV.

EXAMPLE OF MANEUVERING AT EQUIDISTANT POSITIONS.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

A SIMPLE ELECTRIC STEERING GEAR.

By CAPTAIN BRADLEY A. FISKE, U. S. Navy.

The present steam steering gear is pretty good. Breakdowns, however, are far from rare. The cause of breakdown is nearly always found in the transmission rope between the deck and the steering engine, or in the "floating lever" mechanism of the steering engine itself.

Steam steering gear has the disadvantage that the steam pipes and the cylinders of the engine heat the after part of the ship, including the magazines.

Electric steering gear would not have this disadvantage.

Practically all efforts to develop electric steering gear have included the floating lever. As applied to electric apparatus, the floating lever necessitates the use of a great many more parts than as applied to steam apparatus, brings about undue complication, and is the principal cause of the non-success of all electric steering gear.

The writer believes the floating lever unnecessary in any steering engine, and begs leave to cite a few examples, to show that the floating lever has been carefully tried for several kinds of electric work, and found to be both complicated and unnecessary.

About 1889, the Sprague Company installed in the *Atlanta* an electric ammunition hoist, in which the floating lever principle was used. This was the first electric ammunition hoist ever put into any ship, in any navy, and it remained in successful operation for three years. But the complication was so great that the floating lever was discarded, in subsequent hoists, and has never been used in them since.

About 1889, the Sprague Company installed an electric training apparatus on the starboard after 8-inch gun of the *Chicago*. The

same remarks apply to this as to the ammunition hoist in the *Atlanta*.

From 1894 to 1896, the General Electric Company was engaged in developing an electric system for training turrets, with the encouragement of the Bureau of Ordnance. Many plans were tested, some of them including the floating lever. But it was found, not only that the complication was enormous, but that the floating lever would not do; for the simple reason that, although the motor followed the operator's hand, it could not be made to follow fast enough.

In the early spring of 1907, the Department ordered that the electric steering gear of the *Arkansas* be tested carefully. A competent expert was sent from the contractors, and he went with the ship on a trip from Annapolis to Norfolk, and remained on board for several days. He was an exceedingly able and enterprising man, and went over the whole subject most laboriously. At the end, the expert declared that if anybody could see a way to apply electricity satisfactorily to the steering of a ship, *using the floating lever*, he would have to be a great deal smarter man than he himself was.

So, why adhere to the floating lever? We hoist our ammunition without it; we train our turrets and elevate our guns without it; elevators are managed without it; and builders raise enormous masses of steel and stone to the tops of the highest buildings without it. All these things are harder to do than to move the rudder of a ship, and require more precision.

When steam steering gear came into use, many years ago, the inventors used the floating lever, in order that the sailors might use the wheel just as they had learned to do, in steering by hand. But haven't we got beyond that stage now? In those days there were no helm indicators, to tell the helmsman the position of the helm. Now there are plenty of them, and they are very reliable. They get out of order much less often than the steam steering gear, and can be more quickly repaired, if they do get out of order.

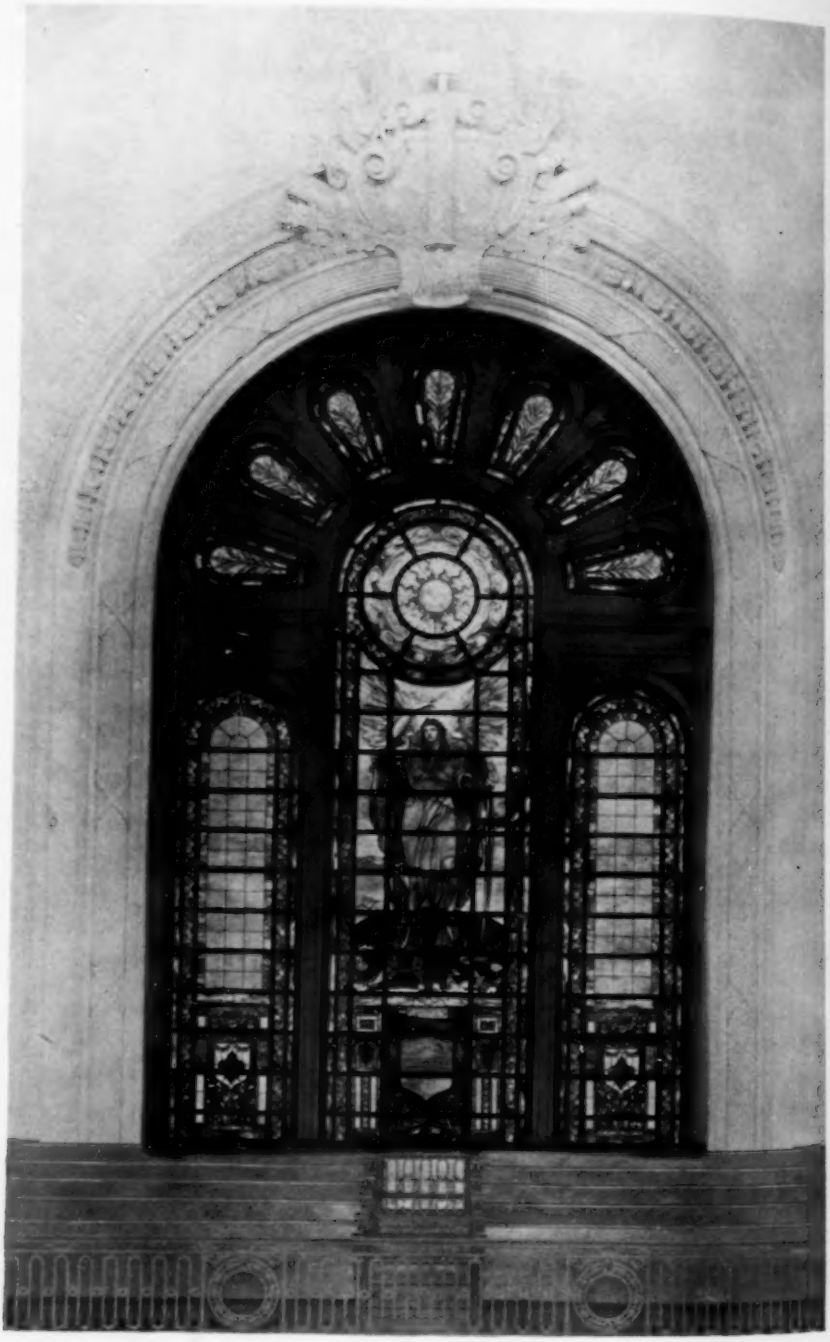
Why not have a simple controller, like those in all our trolley cars and ships, which we all know how to use? It need not be placed near a compass. The helm indicator will tell the helmsman where the helm is; and this is all he wants to know. Duplicate or triplicate leads can be used as standbys, if desired.

This would get rid of a good deal of heat and complication.

* * * * * * * * *

The simplest plan of all, and the one giving the maximum protection to the steering gear in battle, would be to steer by a controller and electric motor in the steering engine room itself. This plan is not *advocated* by the writer; but, as we have found it perfectly practicable to steer from the steering engine room, using a compensated compass there, the idea is *suggested* as one of the possibilities of the future.

The only rival of the steering engine room seems to be the central station; and it may be pointed out that, if the steering engine room were designed with the idea of having a compensated compass in it, there would be more free space around the compass than in the central station, and the compass would be less liable to disturbance by moving masses of iron and changing electric circuits.



THE SAMPSON MEMORIAL WINDOW.

The Memorial Window placed in the Chapel of the Naval Academy at Annapolis, by the officers of the United States Navy, as a tribute to the life and services of the late Rear-Admiral William T. Sampson, was designed and executed by the Tiffany Studios of New York, under the personal supervision of Mr. Louis C. Tiffany.

The Memorial occupies a space above the gallery in the Chapel and consists of three large panels, with seven smaller panels and traceried openings above, completing the architectural contour. The large central panel contains the main subject of the memorial, "Peace." The design shows a sea on which floats a ship, hung with garlands of flowers and surrounded by flying doves. In the bow stands a majestic winged Angel figure, robed in scarlet and white and girt with golden armor. Perched upon her right hand, held aloft, is a white dove, holding in its bill a branch of laurel, and in her left hand she holds a sword in rest.

Above her head is a golden aureole. Below the main-figure panel is a smaller one, in which, resting on two dolphins, is a shield of blue, bearing two stars, the official emblem of naval rank and honor. A tablet just above the shield bears the legend: "Sampson Santiago." The central panel is set in an ornamental border and the side panels are treated in an ornamental design in harmony. The seven small panels in the upper portion of the window bear branches of laurel.

The coloring is rich and brilliant throughout and in perfect accord with the spirit of the design. The glass of which the window is composed was made especially for the work. It is of rare depth and quality of tone and has been used with infinite care in interpreting the full thought of the theme.

At the base of the window is the dedicatory inscription:

WILLIAM THOMAS SAMPSON
Born February 9, 1840
Died May 6, 1902
Erected by the Officers of the
United States Navy

THE CEREMONIES AT THE UNVEILING OF THE SAMPSON MEMORIAL WINDOW IN THE NAVAL ACADEMY CHAPEL

INVOCATION

CHAPLAIN H. H. CLARK, U. S. NAVY.

OUR FATHER IN HEAVEN: We thank Thee for the names in the history of our navy that emphasize the requirements of the naval profession and deepen in its representatives the sense of patriotic privilege and duty. We thank Thee that Thou didst call the one whose name and work give significance to this occasion to the eminence he reached in professional attainments and distinguished service. We thank Thee that Thou didst place him where the trust of the nation was confidingly and unhesitatingly reposed in him, and where he recompensed that great trust with a largeness of vision, a sleeplessness of vision, and a scope of operations that added an impressive page to our national history. And as the memorial to him so lovingly placed in this sacred building shall brighten in the light of successive Sabbath suns, may those who gather here regard it not alone as a fine memento of art to a conspicuous and worthy career, but also as a noble tribute to the profession which in the teaching and training of this institution has its notable beginning. And help us all, our Heavenly Father, in our several places to strive earnestly for that consecration to opportunities and tasks, which, though it may fail of historic mention, shall receive from Thee the final "Well done!" AMEN.

SPEECH OF PRESENTATION

REAR-ADMIRAL F. E. CHADWICK, U. S. NAVY

CAPTAIN BADGER, LADIES AND GENTLEMEN: We are met today to do what is, to many here, and particularly to his comrades, a heartfelt and solemn duty to the memory of a great commander, a noble man, a beloved friend. For Sampson was all these to those who knew him.

Of his greatness as an officer, I need not specially speak to the navy, which ranks him with the very greatest at any time, of our service or of any service, but I cannot omit bearing special witness to that rare nobility of soul which was his in higher degree than I have ever known in any other person, and which (and I say this with the fullest meaning possible) made him the finest character, whether of man or of woman, it has been my experience to meet.

He was ever above any exhibition of anger, ever kindly of thought and speech, of absolute equability of temper and action, of a calm courage which knew no fear, of loftiest sense of duty. I never knew him to utter an unkindly word or say an unkindly thing. Back of a naturally great reserve of manners was a most warm and tender heart. While this reserve at times had a character of coldness, it was not through unkindness, but through his truth. For he was truth itself, transparent and unyielding truth. I well remember calling with him at the New York Navy Yard shortly after his return from the West Indies in 1898, and his meeting an influential personage whom he had never met before, and to whom his manner took on one of his rare exhibitions of coolness. After returning to his flagship, I ventured to reproach him somewhat as to this. He looked at me for some moments without reply, in a pathetic way, and, after a bit, said, as if reproaching himself, "I cannot help it." I felt rebuked. I felt myself in the presence of that unbending truth of soul which could never assume to feel that which it did not feel.

The nearer one got to Sampson, the more one felt his true greatness. The words of one of his staff, "Isn't he splendid? Was there ever anyone like him," have always remained in my memory. They were said on the quarter-deck of the *New York*, at the fall of evening in the earlier days off Santiago. I can remember the setting of the scene, the searchlight from the battle-ship which he had but just begun to use on the harbor entrance, and which, by the testimony of Admiral Cervera himself, was such a determining cause in the American victory. The special reason for the remark has passed from mind; the feeling of its truth, however, has ever remained. The man who can evoke such feeling from those in closest companionship with him is no ordinary man. To such companions he was ever the hero.

The reticence in speech and manner which I have mentioned, was not a detriment to a knowledge of him. His character showed

itself so clearly in look and bearing that no one ever doubted that here was indeed a man. As one who was with him as chaplain, in the *Iowa*, well says: "Until the day of my death my memory and imagination will picture him as a king among men." And he was indeed such; one born great, and never falling short of his greatness. And he was such to the enlisted men who served with him, as well as to the officers who were in closer and more familiar contact. There was, with them, the same enthusiastic feeling of admiration and devotion. And as may be well understood by what I have already said, it was not by any art, or pose, or effort. It was the natural and spontaneous feeling aroused by one who had the attributes which cause us to admire, to esteem, to love.

Such was the man who in life was our beloved friend and chief, and whose memory we delight to honor.

Along with officers who, though long since resigned from the navy, are still in heart part of it, every grade in the service has joined to contribute the beautiful memorial we are about to unveil. Officers and men from every ship and on every station have contributed. It is in every sense a demonstration of service feeling for him who, in every stage of his career, did honor to our great profession, and who was ever foremost, whether as a midshipman here when the Naval Academy was still scarcely more than an experiment; as a watch officer whose beautifully clear and far-reaching voice was an inspiration to the man at the weather earing; as an instructor here again at the Academy, and as its Superintendent, who impressed himself as such indelibly on the memory of some here to-day; as the head of our ordnance and one of the creators of our present navy, and, finally, as the great captain of a fleet, a hundred and twenty-four in all, the largest ever under our flag in one command, which destroyed Spain's only hope in 1898, and ended her dominion in the Americas. His career is a glorious memory to those of us who look back; an inspiration to those who are looking forward.

I have the honor, Mr. Superintendent, on behalf of the Committee, to place in your keeping, and in that of your successors, this witness of the affection and admiration of the navy for Sampson.

The window was then unveiled by Admiral Sampson's two sons, Midshipmen R. E. Sampson and H. B. Sampson, the audience standing and the band playing "The Star Spangled Banner."

SPEECH OF ACCEPTANCE

CAPTAIN C. J. BADGER U. S. NAVY
Superintendent of the U. S. Naval Academy

ADMIRAL CHADWICK, THE COMMITTEE, LADIES AND GENTLEMEN: Speaking as the representative on this occasion of the U. S. Naval Academy, the Alma Mater of the distinguished officer in whose honor we are assembled here to-day, I *accept* the beautiful and appropriate window which is long to aid in keeping green the memory of Rear-Admiral William Thomas Sampson, United States Navy.

In eloquent words, Admiral Chadwick has just summed up the qualities which made Admiral Sampson a great naval officer. They were courage, devotion to duty, loyalty and truth.

This window, then, bearing the name of Sampson, erected here in loving remembrance by all types and classes of navy men, will certainly keep alive in the hearts and minds of the future officers and commanders of our fleets, from here sent forth, those high conceptions of honor and duty which alone can make a great nation or a glorious navy.

Upon us at the Academy is conferred, to-day, the distinction of guarding this splendid memorial to Rear-Admiral Sampson. For those now here and for those to come after us, I can, with equal certainty, declare that the preservation of that window and all that it commemorates and stands for will ever be regarded as one of our most sacred duties.

The choir of midshipmen then sang "The Son of God Goes Forth to War."

ADDRESS

REAR-ADMIRAL A. T. MAHAN, U. S. NAVY

We have just united in an act, the symbolic value of which it is well that we should heed and vividly appreciate; for the inward meaning of that which we have done far transcends in importance the outward deed, though that is significant and appeals to our strongest sympathies. It is well that Admiral Sampson should be remembered, for he is worthy of commemoration; it is well that by a fitting memorial men now should provide that his memory be maintained to generations which shall have known neither him nor us: but beyond all other forms of tribute it is well that his

personality, in its fullness, conspicuous in visible token such as we here place, should stand to us and to our successors for what it was and is: an example to be followed, a stimulus to exertion, an assurance of success, following upon sustained and worthy effort. I repeat, deliberately, "an assurance of success"; for despite the bitter mortification that deprived him of immediate participation in the battle, the conditions of which he had compelled and in all essentials planned, there is and will be, in instructed military opinion, no dispute of his claims to complete personal achievement of that which was committed to him to do. Means and end alike were of his contriving and of his execution; in him the country found the fit instrument, needed for the direction of that which was the decisive factor in the operations of war, in that field to which he was sent; and, if the baubles of triumph were denied him, if even the nation failed for the moment to recognize his full deserts, he had, and he knew he had, the absolute and affectionate confidence of those who most closely knew the facts; of his comrades in the service—especially those under his own command; and of the government, which day by day had been following his career and his measures with increasing approbation. I speak with knowledge; for with that government I was at the moment in close and daily official connection.

Of this appreciation and confidence, the window we have to-day unveiled is to be the mute exponent; the testimonial which we hand down to the years to come. It shall tell them of the esteem we felt for him whom we were proud to name friend and comrade, some of us also to call commander and leader; that we reckon him high among the illustrious examples of that which our common profession, the navy, has been to, and has done for, these United States of America. We talk at times of the old navy and the new. The expression is convenient and necessary; but it should not obscure the more vital truth that the life of the service, which is its spirit of patriotism, devotion, and professional pride, has been, and is, continuous throughout. Therein, the old of yesterday and the new of to-day are one. There may be, from time to time, rare fluctuations of vigor, as the individual man suffers fluctuations of health; but this spirit knows not death. To it there has been neither new nor old. Paul Jones and Nicholas Biddle in the War of Independence; Hull, Decatur, Perry, Macdonough in that of 1812; Farragut, Porter, Dupont, Foote, and a host of

others in the War of Secession; Dewey and Sampson in that with Spain: the one tone and the one efficiency prevail through all. They are brethren in a common household.

Not only to the memory of the dead, then, do we place this memorial. It is a testimony also to an ever living spirit, of which Sampson in his day was a conspicuous illustration. And herein do we most honor him, when we speak less of what he did than of what he was: worthy to be named with those the roll of whom we have called. Our homage is to personality. The unveiling of this window is the symbolical act in which we hold up a man, a character, for reverence. It is the appeal to posterity, that they who are to come after us will absorb and carry on the same tradition, seeing in him a pattern for imitation. Than this there is no nobler praise; and this we give Sampson.

It is fitting, indeed, that for such reasons memorials of the illustrious dead should abound in these grounds and buildings, in which their successors, in future generations, are to pass several of the most impressionable years of life. Duly utilized by imagination, realizing the continuity of a professional ideal concrete in personal conduct, such monuments *speak*. They teach the profoundest and most enduring lessons. In silent eloquence a tombstone may breathe inspiration. The memory of fifty years ago brings before me—I see it now—one such, standing solitary in an unfrequented dell within the grounds of the Military Academy. It read: "Dade and his Command. The whole detachment, save three, fell without an attempt to escape." Such an epitaph does not need interpretation. Its appeal is direct and simple, requiring no analysis. It is otherwise where the lesson is not that of a single heroic act, but of a lifetime of patient duty, culminating, as did that of Sampson, in a brief opportunity, nobly used because of the readiness which springs from long and patient preparation. The eye is caught easily by conspicuous achievement; but attention passes slightingly over the dull routine of duty done and capacity developed. Yet these underlie achievement, and alone make it possible. This is the pregnant lesson of Sampson's life; as it was also of Farragut's, to whom greater opportunities were given, but to whom achievement and celebrity came only after he was sixty.

While the Naval Academy is the appropriate place for memorials of all distinguished naval officers, because there they ad-

dress the most interested audience, and most beneficially affect the welfare of the nation by arousing the emulation of its future sea-warriors, there is a peculiar fitness in such commemoration of Admiral Sampson, whom we to-day honor. Not in death only, or in illustrious example, is he thus associated with the fortunes of this institution. To it in great measure he also gave his energies in his life. From him, in his exertions while living, in the work he did, and in the effect produced by his example, there proceeded influences upon the service which defy measurement. Even at the early age of twenty-two, when a lieutenant, the combination of physical advantages and personal character made such an impression upon the midshipmen of the practice ship, that one of them, writing after near half a century, says he was in their appreciation "a kind of demi-god." Of him a dozen years later, another, who has achieved distinction in civil life, writes: "The perfect self-poise, the clarity of expression and judgment, the certainty of action, his entire approachableness and unfailing courtesy, all coupled with an unobtrusive perfection of discipline, made upon my mind an indelible impression which his whole subsequent career only deepened." Multiply such influence by the numbers subjected to it and we shall understand something of what the navy owes to Sampson.

In this age of science, when we weigh the planets and the solar system, there is danger that we forget the silent, subtile, and therefore more powerful forces, imponderable, which are wrapped up in that mysterious aggregate known to us as personality and character. No natural force is more persistent, more unremitting, or more potent in working. It draws men as steadily as gravitation does the heavenly bodies; and, while thus constant, it is perhaps as little reckoned. Now and again some one's attention is attracted by a special incident, manifesting the influence exerted by character, as that of Sir Isaac Newton was in the familiar story of the falling fruit; but for the most part men seem to themselves and to others to follow their natural bent, unconscious of the decisive deflection imposed upon them by a character stronger than their own, which keeps them true to the orbit they should follow.

Of the weight attaching to Sampson in this respect, there is abundant evidence; and this is the more noteworthy, a stronger testimony to the effect of character, because he was not superficially sympathetic. One who knew him longest and most intimately in

various kinds of service and association, wrote to me, "He never praised." Those who have studied military biography know what a force praise, commendation, appreciation, by a commander, exerts upon the energies of his subordinates. My informant attributed this defect, for in a degree it was such, to the facility with which Sampson accomplished his work of every character. "The daily grind," to quote the expression used to me, was to himself so easy, that he seemed not to realize that another might be helped in his own task by words of recognition. It required something distinctly much beyond the ordinary to elicit admiration on his part, such as his fellow instructors saw him show for exceptionally brilliant minds which came under his direction when head of a department at this Academy.

This seeming absence of susceptibility was temperamental, and reproduced itself in other aspects of character. His self-control was notable, his patience inexhaustible; and it was greatly tested, for he suffered much. After intimate acquaintance of forty years one writes, "He was gentle, charitable, self-contained, never contentious, and infinitely, divinely patient." The close akinship of these several virtues is easy to see. He was unusually insensible to danger. On one occasion the ship he was commanding took fire in the lower hold. There was the usual noise and confusion accompanying such an incident, and doubtless some excitement; but the captain did not appear. When it had been extinguished, the first lieutenant went to the cabin to report, and found Sampson reading. In some surprise at seeing no token of particular interest, and fearing the impression that a mere fire drill had been ordered without the commander's knowledge, the officer remarked, "That was the real thing, Sir." "Yes," was the reply, "I know it was; but I was sure you would put it out." Those familiar with naval biography may recall a very similar story of Admiral Lord Howe, between whom and Sampson there was in this respect a strong constitutional resemblance, as there was also in a patience beyond all proof.

Another exhibition of the same characteristic was the ability to sleep under service conditions provocative of anxiety; this Howe notoriously possessed, and it was in Sampson equally conspicuous. A close observer, his flag-captain during the hostilities with Spain, wrote, "His calm, equable temperament carried him through the nights without any of the sleeplessness usually associated with the

mental strain of great responsibilities." He had a wholesome respect for torpedoes, concerning which he once used to the present speaker the expression, "the torpedo boat is the child of darkness," and he had had a personal experience in the sinking under him of the monitor "Patapsco," by a torpedo, during the War of Secession, the impression from which would, with most men, have lasted a lifetime, as the shock of an earthquake is said to do; but, to borrow Howe's words, "having taken every precaution that he could before dark, and conscious that everything had been done which it was in his power to do, his mind was at ease and he slept perfectly well." Commonplace and common sense though this may sound, it is unhappily the exception, not the rule; and in Sampson's case the more noteworthy, because off Santiago his health was already breaking.

These close and intimate, yet mutually independent, observers, whom I have quoted, agree that this placidity of temperament extended to an indifference to danger in general, amounting to insensibility to the emotion of fear. It is pertinent to remark that the intellectual appreciation of danger, the recognition of the fact, is one thing, but the effect produced is another. In many brave men the danger is ever present to their apprehension, at least until attention is engrossed by action; in a few indifference to it approaches unconsciousness. In his recollections of General Grant, General Horace Porter says he had in his long war service known only two men who never involuntarily moved their head at the near passing of a shell; one was an unnamed trumpeter, the other, Grant. Now and again a rare man is privileged not to feel fear; among such Sampson was, though it is inconceivable that he could say so. "His courage," wrote his fleet-captain, "was of the highest and finest type. If he had any sense of fear for what might happen to himself, it never appeared even in the remotest suggestion. Several commanding officers spoke to me, asking that care be taken not to allow 'Sammy,' as he was affectionately termed, to expose himself too much, his life being regarded as too valuable to undergo any unnecessary risk. Effort was thus sometimes made to have him go into the conning-tower. He was got there once or twice by a little short of main force, but he would not stay; in a few moments he was on the bridge again." The circumstance recalls a fine saying of one of the naval heroes—forgotten, I fear—of the War of Secession, Lieut.-Commander

William Gwin. Unable to see clearly how effective the fire of the ship was, he left the conning-tower with the words, "A captain's place is on his quarter-deck"; and there he fell, mortally wounded.

His flag-captain very properly characterizes Sampson's courage as being "of that highest type which sinks all thought of person in the sense of duty." It was that, doubtless; but it was also something more. It possessed an additional quality which I carefully refrain from calling higher, but which we are justified in regarding as even more useful. To sink fear in duty is great; not to feel fear is a power. This was Sampson's happy gift from nature. "He had an apparent inability to appreciate danger," writes a distinguished officer, for a long period his first lieutenant; and he cites an illustration. "He used to sail back and forth from the shore in Chefoo, often in very boisterous weather, in a long, narrow, single-banked gig—a boat wholly unsuited to sailing; and when the weather was bad I invariably had a boat manned and in readiness to go after him." In this there evidently was no obligation of duty; it was simply indifference to danger, or possibly delight in it—a trait not unfamiliar in biography, and to a military man most valuable, when duly balanced by professional equipment and judgment, as in Sampson's case it was.

I have been dwelling on a series of traits, closely allied, which together illustrate what I think was the dominant characteristic in Sampson's make-up: a temperamental calmness, very rarely disturbed, and having also the defect of the quality in a seeming slowness to share the emotions around him, or to yield to feelings which, under the same circumstances, most men would experience. I speak of this as a defect, which, I may add, was to some extent reflected in his features. These, while unusually handsome in the prime of life, lost from that lack of animation, of changeful expression, which does so much for persons of more ready sensibilities. But I mention the defect in order that it may enhance, as it should, the abundant testimony to the warm sympathies of the real man, which, concealed under this mask of indifference, lay behind the seeming immobility of word and look. It is a profound illustration of the power which character possesses to force its way to the surface, to transpire despite the man's effort to conceal, or lack of effort to reveal, that none who knew Sampson long failed to recog-

nize in him not only solidity and ability, but an appeal to affection, in natural dispositions which he made no effort himself to disclose. Never was man more free from self-exposition, more devoid of self-seeking. Not only did he never play to the gallery—a most commendable neglect for which he greatly suffered—but he never attempted so to modulate conduct as to attract approbation or attachment. He did not make advances. He was content always to be simply himself, to act according to his noble nature and lofty standards; but it happened to him according to the true proverb: "A city that is set upon an hill cannot be hid." Character will out.

Thus Sampson won without effort an attachment, as well as admiration, which, because of less rapid growth, was the more profound, and the more lasting. The roots struck deeper because the feeling began in esteem, and only gradually ripened into enthusiasm and affection, as experience and observation proved the depth and truth of the kindliness which lay below the surface. The personal intimacies which he did not seek, nevertheless found their counterpart in intimacies of appreciation, as men saw his unselfishness and consideration. These qualities showed themselves towards seniors in an incident not generally known, when the honor of chief command against the Spanish West Indies was laid upon him in 1898. When he had read the telegram, he said to his first lieutenant, without elation, and even with sadness, "This is not right, there are admirals and commodores who should have this command." Towards juniors, the same traits, coupled with the confidence in others which springs readily from unconscious self-reliance, led him to manifest in their judgment, discretion and zeal, a trust than which nothing more endears a commander-in-chief. "The feeling in the fleet," says one, "was that that which the admiral wished and intended should at all costs be done."

In professional classification, as distinguished from personal temperament, Admiral Sampson from the first belonged by natural bent, and subsequently by force of circumstances, to the modern type of scientific, progressive officer, who advances from knowledge to knowledge by steady process of acquisition. He had little in common with that older and very excellent class which is the product of continuous association with the atmosphere and environment of the ocean and the ship of war. This difference of types is no new thing; it has always existed. Yet I think it is

accurate to say that, while a blending of the two characters is always desirable, there has been a period in which the training of the sea itself was the school fittest to bring out whatever aptitude a man possessed; but that in our day this training must be imposed upon, and afterwards accompanied by, a constant mental application, closely akin to that of the student. It is unsafe to generalize from an instance so singular in point of natural ability as Sampson was; but, with that reservation, his career may be cited as an ample justification of the scheme of professional development which the United States for fifty years back has embodied in the Naval Academy.

Whether the circumstances of his life, interrupted by calls to sea, permitted Sampson to attain the full accomplishment of the man of science, strictly so called, I am not fitted to judge; but his natural inclinations and his sympathies all lay in that direction. He found his inspiration in men like Lord Kelvin rather than in the naval warriors of olden time; and the scientific appliances of ships of war appealed to him more than the incidents of the deck, or even of command. With such predispositions he naturally, and, with his great mental abilities, inevitably, found his way into the scientific department of the Naval Academy, with the early development of which, after the War of Secession, he was for many years identified. So, in natural course and due sequence, he came in time to be Chief of the Bureau of Ordnance, which above most of the line bureaus requires scientific acquirement. Here the large knowledge of the laws of physics, acquired and digested during his long previous service, enabled him to grasp the scientific side of artillery and ordnance with ready facility; and his work in the bureau was eminently distinguished as regarded scientific progress.

In connection with this assignment should be recalled an incident most characteristic of the man, both in disregard of personal considerations, and freedom from—lack of sympathy with—certain susceptibilities natural to the profession, but often misdirected. Before assuming the duty he applied for "duty under the present administration of the Bureau of Ordnance"—I am quoting his own words; the administration being then in the hands of an officer much his junior, who indeed had been at one time first lieutenant under his command.

This incident shows not merely a certain superiority to ordinary

professional jealousies, instances of which we all have seen, sometimes just, sometimes petty, fostered by our system of promotion by seniority alone. His action manifested the concentration of purpose, the singleness of mind, which leads on to success. Sampson knew that he yielded professional claims in this case, just as he knew he was safer in the conning-tower, and that there was danger in his boat sailing; but, with an object in view, his indifference to secondary considerations approached insensibility. He expected to be Chief of the Bureau; all question of personal dignity, as involved in official rank, simply disappeared before the engrossing object of fitting himself for the task. He could have understood, as a mental proposition, that other men might feel differently; but as a motive for practical action I think such susceptibilities would have passed his comprehension.

This incident, illustrative alike of personal and of professional character, may fairly be cited as evidence of that great element of success which Napoleon called exclusiveness of purpose. "This," he wrote to his naval Secretary, "is the art of great successes and of great operations. The absence of it is a fault." Exclusiveness of purpose was a very large element in Sampson's make-up. It was this which, despite his strong leanings towards science, decided him to reject the offer of being permanent head of a department of the Naval Academy, to the founding of which on a solid basis, and to its subsequent development, he so largely contributed. The navy stood first to him; it was his career; and while affection for it admitted other pursuits, so far as they contributed to the progress of the navy, and to perfecting himself as an officer in it, it admitted them only as subordinate occupations, not as rivals.

This exclusiveness of purpose, logical in conception and remorseless in execution, inevitably took shape with him in concentration of energy upon the work immediately before him at any particular moment. To this was due that the man, naturally a lover of science, and a student, was so emphatically successful, so admired, as captain of a ship and as a commander-in-chief during hostilities. The scientific man and the student disappeared, as active factors in thought or conduct, however much the acquisitions due to them may have promoted the efficiency of the general officer.

To a certain extent concentration must be purchased by a sacrifice of breadth; diffuseness would be a more accurate word. Human beings are limited, and he who would be deep must consent to cir-

cumscribe his activities. To do so means sacrifice, sacrifice of immediate enjoyment, and ultimately of a certain charm which clings around a person who has many interests, touches life at many points, and so can be sympathetic to many people and many pursuits. Such persons have their place in the garden of life, the pleasure of which they enhance; but they are not the oaks of the forest. This sacrifice Sampson made, perhaps unconscious that it was one; for exclusiveness and concentration of purpose were to him intuitive. While preparing for the Ordnance Bureau he lived for three months with the then chief, who writes, "We talked of little else than ordnance, its history and present conditions, as far as we were acquainted with it. He read little but scientific works and periodicals. I do not recall ever seeing him read a novel, and he cared little for historical subjects or general reading. This side of his temperament and taste was often a source of regret to me, as it left us without resource in conversation after discussion of the shop."

Many will recall that Darwin expressed his sense of similar limitations, which are not so much the defect of a quality as the price that must be paid for mastery at once deep and comprehensive in a particular line of thought or action. That lack of general interests, or, as we say, of wide sympathies, makes a man less generally attractive, less immediately likable, but not less lovable. Width and superficiality of culture may give charm, but depth and love have much akin. Sampson inspired in those who knew him closest an enthusiasm little distinguishable from love, and the more notable because of that external impassiveness of which I have spoken. But with this there went a serenity of temper and of bearing, a justice of outlook, a courtesy of manner, and an impression of sustained and latent force which inspired confidence; and the confidence was not betrayed. It grew with contact and ended in affection, a triumph of character which stood every test, a house founded on a rock.

Young gentlemen, still students at the Naval Academy, who sit now where once sat Dewey and Sampson and Cushing, all graduates of the school; and you, also, who, still in the prime of manhood, have passed hence into the more active service of your country, learn from Sampson, and from men of the past like him, to value character above every professional gain. With the simple directness of the Word of God, keep your heart, in which arise

your dearest ambitions, above all keeping; for out of the heart are the issues of life. The testimony of the ages is conclusive that this proverb is true of the one great issue of life, of its crowning success; which is, the witness of one's own conscience, personal and professional, to duty done. To Nelson, in the hour of death, the glory of Trafalgar and of all his past victories was less than the witness of his conscience that he had so kept his heart. He spoke not then of the fame which had been dear to him, but he repeated continually, "I have done my duty." In the flush of active life, he had quoted concerning himself, "If to covet glory be a sin, then am I the most offending soul alive"; but the hour of mortal weakness, when truth asserts its sway, and things are seen in true proportion, and the secret of the heart is unlocked, disclosed to mankind that, dear as glory had been to the hero, duty had been dearer still. This keeping of his heart had been his great success.

Of this no man need fail, nor of the sure reward it brings; for the keeping of the heart is character, and character cannot but transpire. The most sedulous craft cannot impose finally upon intimate acquaintance; nor can sustained integrity of purpose escape recognition. The well-kept heart, of which the wise man spoke, is the spirit of that which Nelson called Duty, and Jesus Christ, the Single Eye. It gives a light which can pierce the darkness of conflicting impulses, a voice which speaks with no uncertain sound. Our dead Farragut and Sampson saw, and heard, and followed. The navy recognizes them, and the nation yet will.

BENEDICTION

CHAPLAIN H. H. CLARK, U. S. NAVY

May the love of God, the grace of our Lord and Saviour Jesus Christ, the communion and fellowship of the Holy Ghost, be and remain with you all, evermore. AMEN.

DISCUSSION.

Some Ideas About Organization on Board Ship.

PRIZE ESSAY.

REAR-ADMIRAL ASA WALKER, U. S. NAVY.—From my point of view, Mr. King's essay is altogether admirable, both in suggestion and composition.

Such organization as he advocates would place our personnel on an advanced plane in efficiency and economy.

I am unable to make any adverse comment on any point that he has treated, though, naturally, some of them would bear amplification. They are all most sound and easy of application.

The scheme for doing away with that old-time rabble, the "Powder Division," is an inspiration in the right direction and its adoption would be hailed with enthusiasm by the naval service.

I have never read a paper with which in its entirety I so fully agree.

CAPTAIN A. C. DILLINGHAM, U. S. NAVY.—The conception of organization and administration, as laid down by Lieutenant King, is admirable, and I believe if adopted will add to the efficiency of the ship.

When serving as executive officer of a gunboat and two battleships, I put in force almost the identical system of organization and administration as suggested by the author, excepting that the powder division did exist, but at that time it was apparent that greater efficiency would have been the result by distributing the powder division as suggested by Lieutenant King.

In the administration, I became the general manager of the plant, under the directions of the commanding officer, leaving the details of each division to divisional officers. I would even go further than is suggested by the author in turning over to the divisional officers all matters pertaining to their divisions, leaving to the executive officer a rigid supervision of all the units.

To get the greatest percent of efficiency out of a command, it is necessary that the character and personality of each and every individual in the command should be known and appreciated, and it is quite impossible for the executive officer to accomplish this, but very easy, and a matter of necessity, for the divisional officer.

I believe that it is desirable, aboard ship, to have the relations between the divisions and divisional officers such as exist in the army between the company and the company commander.

In the matter of supplies of material, clothing, small stores, and money, it should be left entirely in the hands of the divisional officer, he would be limited only by the allowance as established by the executive officer.

I am in entire accord with Lieutenant King, but I notice that he has made no provision for marines aboard ship as part of the ship's company.

Efficiency is the basis of all organization, and if we get the minimum efficiency aboard a ship manned entirely by soldiers, it is fair to suppose that we will get the maximum percentage of efficiency in a ship manned entirely by sailors. It goes without saying that if there is any unnecessary element aboard ship which detracts from its efficiency, that element should be removed. However, if for other than military reasons marines are to be in the complement of a man-o'-war, then to get the highest percentage of efficiency, we must, by education and training, turn the marines into men-o'-warsmen as soon as possible. To this end complement of marines should be sufficient to man a secondary gun division, and in this organization they should be handled and considered, *in every respect*, as any other gun division of the ship's company; in other words they will become men-o'-warsmen and be identical with the rest of the ship's company, excepting in the matter of uniform.

It might be better to have the marines as part of the ship's staff, but if they have come to stay and are allowed in sufficient numbers, the sooner we make them identical with the other members of the ship's company, the better.

Referring particularly to the paragraph on page fifteen, "Petty Officers *vs.* Rated Men":

It is only necessary to look over the allowed complement of a battleship to-day to realize the large number of men in a ship's company who are wearing petty officers' badges on their arms.

The conditions that exist in the service in this respect cannot be better set forth than is done by the author. Some two years ago I wrote the Bureau of Navigation upon this subject and submitted a list of ratings that should be petty officers from a military viewpoint, and I believe the Department appreciates the present faulty condition existing in having no discrimination between petty officers and rated men, and is ready to put into force, at a convenient time, the suggestions that have been made upon this subject.

The consideration of this question I believe to be most important, for it affects most seriously discipline and efficiency.

I trust that the Bureau will see fit to make the necessary change in the regulations.

Regarding this discrimination between petty officers and rated men, the author might insert, as number three on page twenty-five: "Increase the responsibility and authority of petty officers while in no way detracting from the position or proper performance of duty of the rated men."

The Reorganization of the Naval Establishment.

REAR-ADMIRAL CASPAR F. GOODRICH, U. S. NAVY.—Having, like Charles Dickens' Joe, a "slow mind," I fear I may not grasp all the niceties of metaphor which this interesting article presents, but where I can put myself in the writer's place, his views seem often correct. For example: No one can deny his contentions that "The industrial and commercial part of the naval establishment is the auxiliary of nothing; it is a main part"; and that "At the point where the line officer is obliged to break off, to keep his sea efficiency intact, the staff corps begin"; and that "The sea officer of the line should have nothing to do with the procuring or keeping of supplies in store, and the accounting for value, except as 'senior officer present.'" In the latter case I suppose he does not include ammunition, etc.

I am not among those who believe it well to keep the line officer always at sea and thus to prevent him from identifying himself to a certain extent with the shore-going part of the navy (by far its most costly branch). As much that adds to his efficiency can only be learned on shore, I deem it rather the part of wisdom to give him ample opportunity for studying the construction, arming and equipment of ships before they go into commission, for gaining touch with shop organization and methods and for acquiring an insight into business ways, for, after all, the navy is a large business enterprise, handling vast sums of the public money each year. Its officers could not, if they would, divorce themselves from the necessity of spending these millions prudently and economically. Heretofore this knowledge has been gained by actual control of the work itself, but since a recent general order of the Navy Department takes this responsibility out of the hands of the line officer and makes him only an inspector, it is possible that he will have even more abundant occasion for overlooking the work while in operation and at its completion, than when he was, himself, accountable for its proper execution.

Believing, as I do, that the broadest knowledge is essential to correct appreciation, Pay Inspector Mudd's idea appeals strongly to my sense of the appropriateness. "What the writer would like to see before anything radical is done would be the stationing of sea officers of the line in the various bureaus for two months, these officers selected preferably from those who are quite dissatisfied with present conditions. Have one in the office of each bureau chief, to remain constantly by that chief during his work day, having the privilege of reading any paper that passes through the office. Change these students at the end of the first month so that each will have had experience in more than one bureau at the end of the time of study. When the time expires, have them submit individual reports of what they do not like and suggest remedies."

The suggestion is eminently sensible and practical that officers entering a staff corps should be on probation for two years and retained only if very desirable. It is notoriously difficult to get rid of an officer who barely keeps himself up to the lowest limit of efficiency.

His remarks upon navy yards are particularly interesting to me at this

moment. I should say, as a rule, that nothing should be manufactured by the government which it can buy at a reasonable price from an outsider.

I quote with approval the following: "It has been whispered that the line officer commandants ought to go, when consolidation of shops, etc., is effected at all the yards, and in their places be substituted superintendents selected from the industrial branch. That is bad. There should always be a sea officer of the line in command of a navy yard. A yard's structure is not along the lines of the Navy Department proper, with the Secretary present as its head. The fact that there are almost constantly present at an important yard active units of the fleet, which often embrace a flag officer's ship, is reason enough for having the yards commanded as they are now, let alone several other excellent reasons not necessary to mention."

With his allegation that the New York Navy Yard has been cramped for years for lack of proper equipment in the way of buildings, I am not able to agree. The further ahead we proceed in our scheme of consolidation, the more room we have at our disposal. Old wooden sheds are being torn down and large buildings have become available for new and unexpected employment. In point of fact, we have practically all the buildings we want, and some will be left almost entirely vacant. I should regret seeing the cob dock given over to industrial and material purposes of the navy, for I think the more the shops and stores can be concentrated along the water front, the better.

Neither can I endorse his statement that "All of the small navy yards and stations should be closed, but not sold; they could be put in charge of care-takers selected from worthy retired officers." The only way to keep the small navy yards closed is to get rid of the land entirely, otherwise local pressure will surely, as in the past, reopen them.

The Department is now forming plans by which to provide for the people whom Pay Inspector Mudd very properly indicates as most desirable for under inspectors.

Navy yards for the navy will come about when no member of either the House or Senate Naval Committee represents a district in which a naval station is placed. It is understood that Mr. Speaker Cannon's views are along these lines. I think it would be well if the Senate were to govern itself similarly.

I think the whole naval service should be grateful to the writer for giving his opinions. Whether we agree with him or not is immaterial. Out of the discussion which is bound to follow so illuminating an essay, great good to the naval service will be gained.

We must, like him, cultivate the open mind and engage in the search after truth, for truth's, and not our own individual sake.

PROFESSIONAL NOTES.

Prepared by Professor PHILIP R. ALGER, U. S. Navy.

SHIPS OF WAR, BUDGETS AND PERSONNEL.

AUSTRIA.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battle-ships.			
Radetsky	14,500	Trieste.	Building.
Zrinyi	14,500	"	"
Erzherzog Franz-Ferdinand.	14,500	"	Launched Sept. 30, 1908.
Scout.			
Admiral Spaun	3,500	Pola.	Building.

The *Moniteur de la Flotte* states that the three battle-ships of *Radetsky* type are to be fitted with torpedo nets.

BRAZIL.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battle-ships.			
Minas Geraes	19,250	Elswick.	Launched Sept. 10, 1908.
Rio de Janeiro	19,250	"	Ordered.
San Paulo	19,250	Vickers.	Launched March 20, 1909.
Scouts.			
Bahia	3,500	Elswick.	Launched Jan. 20, 1909.
Rio Grande	3,500	"	Building.

The scout *Bahia*, which Sir W. G. Armstrong, Whitworth & Co., Limited, have on hand for the Brazilian Government, was successfully launched from the Elswick shipyard on January 20. Two such vessels were included in the Brazilian program, the second of which is to be launched early in March. The remainder of the program comprised battle-ships and torpedo-boat destroyers. The *Bahia* might be regarded as a development of the scout type represented in the British Navy by H. M. ships *Adventure* and *Attentive*, which were also designed and built at Elswick three years ago. They had proved on trial to be the fastest of their class, of which there were eight. The *Adventure* attained a speed of 25.4, and the *Attentive* 25.88 knots. The *Bahia* was not unlike the scouts of the British Navy, but was slightly larger and heavier than the *Adventure* and *Attentive*, and it was hoped to attain a speed of 26½ knots. She would be propelled by machinery of the Parsons turbine type. The *Bahia* would carry an exceptionally powerful armament for a vessel of her type—ten 4.7-inch guns, six 3-pounder guns and two torpedo-tubes.

The name *Bahia* had always been a distinguished name in Brazilian history. It was the coast of Bahia that the intrepid Portugese discoverer, Pedro Cabral, first sighted in 1500; and when the king of Portugal, Don John, left Lisbon, and was flying from Napoleon, it was in the Portuguese colony of Brazil that he took refuge, and it was at Bahia that he landed. In modern days Bahia was known as one of the richest and most famous States of the Republic of Brazil, and was celebrated all the world over for its splendid coffee.—*The Engineer.*

FRANCE.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battle-ships.			
Danton	18,350	Brest.	Building.
Mirabeau	18,350	Lorient.	"
Voltaire	18,350	Bordeaux.	Launched Jan. 16, 1909.
Diderot	18,350	St. Nazaire.	Building.
Condorcet	18,350	"	"
Vergniaud	18,350	La Seyne.	"
Armored Cruisers.			
Edgard Quinet	13,644	Brest.	Launched Sept. 21, 1907.
Waldeck-Rousseau	13,644	Lorient.	" Mar. 4, 1908.

NAVAL PROGRAM.—It does not seem to be questioned anywhere that battle-ships must be laid down, and probably M. Thomson's intention of laying down three of this class will be carried out in 1910. The Superior Council of the navy is about to meet to discuss the characteristics of the proposed new vessels. The composition of the council has undergone changes, and it is impossible to say whether its views will have been modified. When it met in 1907, the plan proposed was that the main armament should be that of the *Danton* class—four 12-inch and twelve 9.4-inch—the secondary armament being increased to eighteen 3.9-inch and eight 3-pounders. It was also proposed to have four submerged torpedo-tubes instead of two; to give 4-inch protection to the six casemates of some guns of the secondary armament, besides providing further protection for the funnels; and to abandon the system of anti-torpedo defence placed in the *Dantons*, recent trials at Lorient, and others with sections of the *Bouvet* and *Henri IV*, having shown that the most ingenious system of cellular defence can do very little to protect a ship from the consequences of a serious explosion against the hull. There was no real unanimity as to the characteristics of the intended ships. The Naval Staff inclined to unity of caliber, as in the *Dreadnought*, while the Director of Naval Artillery's proposal of sixteen 10.6-inch guns in eight turrets was supported by M. Chautemps. On the other hand the Superior Naval School, by the voice of its two latest professors of strategy and tactics, proposed twenty 9.4-inch guns, firing three rounds per minute, with an effective range of 8000 meters. Which solution of the problem will be adopted by the reconstituted Superior Council it is impossible to forecast.—*Army and Navy Gazette.*

THE NEW DIRECTOR-GENERAL OF NAVAL ARTILLERY.—As the result of the numerous gun mishaps, some of a very serious nature, accompanied by heavy loss of life, which during the last three or four years have occurred in the French Navy, and of the continually recurring friction between the military officers controlling the Ordnance Department and the responsible naval authorities, M. Thomson, the Minister of Marine, shortly before his resignation, decided on the creation of a Naval Ordnance Department (Le Direction Centrale de l'Artillerie Navale), and appointed Rear-Admiral Le Bris as the first Director-General. The new department is constituted on the same lines as that of the Naval Construction, and consists of a central department and a technical section. Rear-Admiral Le Bris is invested with complete and absolute authority over the chief of the technical section, the ordnance branches, the pyrotechnics and powder magazines at the ports, the central laboratory, the experimental commission at Gâvres, the ordnance factory at Ruelle, the gunnery school, the gunnery training of the men and firing practice of all the fleet in commission. All the *personnel* attached to these different services depend entirely upon him; in a word, the admiral becomes the supreme head of the naval artillery.

Rear-Admiral Le Bris is the youngest officer on the flag list, being only

in his fifty-third year, having reached his present rank last June. He has the reputation of being the best gunnery officer in the service, and was for some time in command of the sea-going gunnery training-ship *Pothuau*. —*United Service Institution.*

The *Voltaire*, the first of the French *Dreadnoughts*, was launched at the La Seyne yard on January 19. Her length between perpendiculars is 145 meters, greatest beam 25.8 meters and normal draft 8.26 meters. Her propelling machinery is of the Parsons turbine type, and is to give a speed of 19.25 knots. Her battery consists of four 12-inch guns in two axial turrets, twelve 9.4-inch in six turrets and sixteen semi-automatic 3-inch in the upper casemate. She has two under-water torpedo-tubes and is protected against torpedo attack below the armor-belt by longitudinal armored bulkheads (1.8 inches thick), placed about six feet from the outer plating. The *Voltaire* is to be ready for service in April, 1911.

GERMANY.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battle-ships.			
Nassau	18,000	Wilhelmshaven.	Launched March 7, 1908.
Westfalen	18,000	Bremen.	" July 1, 1908.
Rheinland	18,600	Stettin.	" Sept. 24, 1908.
Posen	18,600	Kiel.	" Dec. 12, 1908.
Ersatz Oldenburg	18,600	Wilhelmshaven.	Building.
" Beowulf	18,600	Bremen.	"
" Siegfried	18,600	Kiel.	"
Armored Cruisers.			
Gneisenau	11,600	Bremen.	Under trial.
Scharnhorst	11,600	Hamburg.	" "
Blücher	15,000	Kiel.	Launched April 11, 1908.
F	17,000	Hamburg.	Building.
G	17,000	"	"
H	.....	.....	To be laid down in 1909.
Protected Cruisers.			
Emden	3,800	Kiel.	Launched May 27, 1908.
Kolberg	4,300	Danzig.	" Nov. 14, 1908.
Mainz	4,300	Stettin.	" Jan. 23, 1909.
Ersatz Schwalbe	4,500	Kiel.	Building.
" Sperber	4,500	"	"
" Falke	.....	.....	To be laid down in 1909.
" Bussard	.....	.....	" " " "

One of the three battle-ships to be laid down in 1909 (*Ersatz-Frithjof*, *Ersatz-Hildebrand* and *Ersatz-Heimdale*) has already been ordered from the Schichau firm of Elbing, and every effort is being made to complete within thirty months the three battle-ships laid down in 1908 (*Ersatz-Oldenburg*, *Beowulf* and *Siegfried*). The armored cruiser *G* was begun in the Blohm & Voss shipyard, at Hamburg, in September, 1908.

LAUNCHES.—The new first-class battle-ship *Ersatz-Baden* was launched from Krupp's Germania yard at Kiel on December 12, 1908, and received the name of *Posen*. She is the fourth ship for the German Navy of the so-called *Dreadnought* type to take the water during the past year, the other three being the *Nassau*, the *Westphalen* and the *Rheinland*. All that is known definitely about this group of vessels is that they will have a displacement of 18,000 tons, but no other reliable details as to their armor, armament, horse-power and speed have been allowed to leak out.

It is believed that the next group of four, viz., the *Ersatz-Beowulf*, *Ersatz-Siegfried*, *Ersatz-Oldenburg*, and *Ersatz-Baden*, will be larger than their predecessors, as the first vote for these ships, which appeared in last year's estimates, amounted to £275,000 per ship, as against a vote of only £150,000 per ship for the earlier vessels of the type.

The small cruiser *Ersatz-Greif* was launched from the Schichau yard, Danzig, on November 14, and received the name of *Kolberg*. She is a vessel of 4300 tons displacement, with turbine engines to develop 20,000 horse-power, and give a speed of 25.5 knots. The armament will consist of twelve 40-caliber 4.1-inch Q. F. guns, with four 55-caliber 2-inch guns and two submerged torpedo-tubes. There will be an armored deck two inches thick, tapering to .8-inch, and the conning-tower will be protected by 4-inch armor.—*United Service Institution.*

COALING TIMES IN THE HIGH SEA FLEET.—The best record per hour during the past year for coaling out of lighters by the High Sea Fleet is as follows:—1st squadron: The *Kaiser Wilhelm der Grosse*, 383 tons, and the *Wittelsbach*, 332 tons. 2d squadron: The *Elsass*, 328 tons, and the *Hessen*, 324. Among the large cruisers the *Yorck* took in 435 tons (the best record of the whole fleet), the *Roon* following with 331. Of the small cruisers, which wheeled the coal on board in barrows from the land, the *Lübeck* took in 260 tons, while the *Hamburg*, with a crew of 172 men all told, took in 525 tons in two hours and a quarter, the average per head in the best hour's working being 1.7 tons.—*Marine Rundschau, Kreuz Zeitung* and *Revue Maritime.*

The German small cruiser *Mainz*, built under the appellation of *Ersatz-Jagd*, and launched at the Vulcan yard, Stettin, on January 23, is the latest to take the water of the long series which may be said to have begun with the *Gazelle*, launched in 1898. There are now twenty-five of these cruisers in the water, rising from the 2603 tons and 18 knots of the *Gazelle* to the 4232 tons and 25.5 knots of the *Mainz* and her sister, the *Kolberg*, which latter was launched in November. Two others of the class, somewhat larger, the *Ersatz-Schwalbe* and *Ersatz-Sperber*, are building, respectively, at the Germania and Imperial yards, Kiel, and two others, the *Ersatz-Bussard* and *Ersatz-Falke*, are to be laid down. Germany has now quite a fleet of these small, swift cruisers, intended to serve on the routes of commerce, and is building rapidly. The *Ersatz-Schwalbe* will have Zoelly turbines, and the *Ersatz-Sperber*, like the *Kolberg*, *Dresden* and *Lübeck*, turbines of the Parsons type. The *Mainz* has turbines of the design of the German General Electrical Company. All the others have three and four cylinder triple-expansion engines, and from the *Königsberg* (1905) onward Schulz or Thornycroft-Schulz boilers. The *Gazelle* is fitted with the Niclausse type. The armament consists of ten 4.1-inch and ten 1.4-inch, but from the *Königsberg* onward eight 3.4-inch were substituted for the latter, and the *Dresden*, *Emden*, *Kolberg* and *Mainz* have an armament of twelve 4.1-inch and four 3.4-inch.—*Army and Navy Gazette.*

GREAT BRITAIN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battle-ships.			
Téméraire	18,600	Devonport.	Under trial.
Superb	18,600	Newcastle.	Launched Nov. 7, 1907.
St. Vincent	19,250	Portsmouth.	" Sept. 10, 1908.
Collingwood.	19,250	Devonport.	" Nov. 7, 1908.
Vanguard	19,250	Vickers.	" Feb. 22, 1909.
Neptune	20,000	Portsmouth.	Building.
Armored Cruisers.			
Indefatigable	18,000	Devonport.	Building.
Cruisers.			
Boadicea	3,350	Pembroke.	Under trial.
Bellona	3,400	"	Building.
Liverpool	3,400	Vickers	"
Bristol	3,400	Brown & Co.	"
Gloucester	3,400	Beardmore.	"
Newcastle	3,400	Armstrong.	"
Glasgow	3,400	Fairfield.	"

The decision of the authorities in regard to the names of the two armored vessels to be built at Portsmouth and Devonport, respectively, has caused a certain amount of surprise, since it was expected that the first-named would have been called the *Foudroyant* and that a new name would have been selected for the armored cruiser. Instead of this the Admiralty have decided to call the battle-ship the *Neptune*, while the cruiser will be called the *Indefatigable*—a name already in use and in the "Navy List." It may be conjectured that to some extent the authorities have been influenced in the matter by a desire not to introduce new names in the signal books, and from the point of view of economy it may be that something is to be said in favor of this reason for adhering to names already in use. At the same time, too much may be made of this matter, and we do not believe that the country would complain of the extra expense, whatever it may be, which might arise by the introduction of a new nomenclature if the names selected could be shown to be more fitting than those already on the list. *Neptune* is a good name, and it was the name of one of the ships at Trafalgar, and no one can object to its being conferred upon a first-class vessel. *Indefatigable* is also a name which is to be found upon some of the most brilliant pages in our naval annals, and it accords very well with the names already given to the ships of the same class.—*Army and Navy Gazette.*

The decision of the Admiralty to name the five new cruisers after important cities—*Liverpool, Bristol, Gloucester, Newcastle* and *Glasgow*—seems to meet with general approval. This was to be expected, seeing that the plan of naming the *County* class in the territorial scheme proved a success. Indeed, it may be said that in giving names to all new vessels added to the fleet, the Lords of the Admiralty have been influenced by two-fold motives, that of carrying out a systematized method of conferring names and at the same time giving general pleasure to the public in doing so.—*United Service Gazette.*

Orders for new second-class cruisers of the *Boadicea* type have been placed with Messrs. Beardmore & Co., Vickers, Sons & Maxim, Sir W. G. Armstrong, Whitworth & Co., the Fairfield Company and John Brown & Co. Each firm named will build one cruiser. The speed is to be 26 knots and the engine horse-power 22,000. The lowest accepted tender for any one of these cruisers was about £292,000 and the highest slightly over £300,000. Seven more destroyers have also been ordered quite recently, J. S. White & Co., of Cowes, getting two and the following firms one each: Hawthorn, Leslie & Co., J. Thornycroft & Co., Beardmore & Co., Denny Bros. and the London & Glasgow Engineering & Iron Shipbuilding Co. Some months ago, it will be recalled, an order for nine 27-knot destroyers was divided between Cammell, Laird & Co., the Fairfield Company and John Brown & Co. We understand that the penalty clauses in the new contract are extremely severe. It is reported that no less than £9000 will be forfeited if the speed on the reliability trials is less by one knot than the contract speed and £20,000 if the deficit falls to two knots. The price of these boats is about £110,000 each, which is considerably more than the cost of the first nine, which were placed for £900,000, some being as low as £97,000 each. The severe penalty clause mentioned above accounts probably, in part, at least, for the difference.—*The Engineer.*

The *Bellerophon*, the second English battle-ship of the *Dreadnought* class, was put into commission on February 20. The *Téméraire* and *Superb*, the third and fourth *Dreadnoughts*, have been delayed by labor troubles and will not be completed till June or July, of this year. The *Neptune*, the eighth of the class, just begun at Portsmouth, is said to be of 20,250 tons displacement; 1650 tons bigger than the *Bellerophon's* and 1000 tons bigger than the *St. Vincent's.*

No cruising turbines are to be fitted in the new second-class cruisers or in the new *Indomitable* which is to be built at Devonport. They have been a doubtful advantage from the first, and though there is a very slight gain in economy to be anticipated from their adoption at the very lowest speeds, it does not outweigh the attendant disadvantages in weight and space required. They are to be fitted, however, in the 27-knot destroyers, but in the case of this class the range of power is so much greater that their adoption possesses attractions. Recent trials show that if they are disconnected entirely the propulsive results are slightly improved. When not used they simply act as air brakes, and induce a large amount of negative work.—*The Engineer.*

THE "NEPTUNE."—The new first-class battle-ship *Neptune* was officially commenced at Portsmouth on Jan. 19, and as much material has been collected in readiness, her construction should now proceed rapidly. The new ship will be an improvement not only on the *Dreadnought*, but also on the *St. Vincent* class. Her dimensions are, it is stated, to be as follows: Length, 510 feet; beam, 86 feet; displacement, 20,000 tons (about), and her speed is to be 21 knots. Her armament will be the same as earlier vessels of the type, viz., ten 12-inch guns, mounted in pairs in barbettes—one forward, two astern and one on either bow. The inner after turret is to be raised so that the guns will fire over the top of the extreme stern turret, which will give an additional stern fire of two guns more than the earlier vessels of the class. The anti-torpedo armament will consist of a new type of 4.7-inch guns.—*United Service Institution.*

The armored cruiser of the *Invincible* class to be laid down in February at Devonport dockyard, under the current estimates, is to be called the *Indefatigable.* She will mark a considerable advance on the three previous battle-ship cruisers of the same class, and in regard to speed is expected to establish a world's record for ships of her type. The following are particulars of the new ship, with corresponding details of the *Invincible* class showing the extent to which the new vessel will be an improvement on the earlier units:

	Invincibles.	New Ship.
Length	530 feet	570 feet
Beam	78 feet 6 inches	79 to 80 feet
Displacement	17,250 tons	18,000 tons
Horse-power	41,000	45,000
Speed	25 knots	28 knots

No maritime power has an armored cruiser building with speed to compare with that to be attained in the new vessel. Though the *Indefatigable's* designed speed is 28 knots, three knots above that of the *Invincible, Inflexible* and *Indomitable,* each of which has exceeded the contract speed by at least two knots, it is quite expected that the new ship's turbines will give a speed of not less than thirty knots. This high speed may be attributed to the increase in length, and to the additional power to be developed. The *Indefatigable* will be the longest war ship ever built.—*United Service Gazette.*

HEIGHT OF FUNNELS.—Vessels of the *Shannon* class are to have their funnels lengthened some 15 feet on account of the smoke nuisance affecting the bridge. The *Indomitables* also suffer from this and with a following wind the navigating bridge is almost uninhabitable. In these vessels the bridge has been reduced to a minimum. For exaggerated dimensions of bridge and chart house, the *Swiftsure* and *Triumph* can hardly be exceeded.—*The Engineer.*

The destroyer *Tartar* in recent trials maintained a speed of 37 knots for six hours, and a speed of 40 knots for one hour.

Some of the newspapers have been a little too previous in their descriptions of the new cruiser whose keel plate was laid down at Devonport on Monday. "The biggest cruiser the world has yet seen," as the Admiral-Superintendent at the dockyard called her. It is quite true that the *Indefatigable* will be an improvement upon her three predecessors of the *Invincible* class, but she is not to be fitted with the gas-producer engine and she will have funnels and tripod masts like her elder sisters. It is rather amusing that the statement which appeared in the *Westminster Gazette* should have been telegraphed to America, where their counterpart to our Syndicate of Discontent has promptly attacked the United States Navy Department for being behind the British Admiralty. The gas-producer engine will come, but there are several difficulties to be surmounted before that happens. Experiments are being made with trial plant at Haslar and elsewhere. Note has been taken, too, of the work done in the *Rattler*, but so far no results have been sufficient to justify the application of the system to a vessel of the size of the *Indefatigable*. On the other hand, it has been decided to try the Curtis turbine in one of the new ships of the *Liverpool* class, and some interesting competitive trials will come off when these ships are finished, recalling the trials made with frigates bearing the same names in the 'sixties. It appears to have escaped the attention of most of the descriptive writers on the launch of the *Vanguard* that, alongside the slips from which that vessel took the water, the keel plate of the *Liverpool* was already laid, although it is less than three months since the Vickers firm received the order to build her.—*Army and Navy Gazette.*

RE-SIGHTING NAVAL GUNS.—The Admiralty are to be congratulated on the smart manner in which the whole of the ships of the fleet have had their guns re-sighted and brought up to date. Such a task as altering the sighting apparatus of every gun in a navy so large as the British is obviously a stupendous one, and calculated to take an interminable period of time, unless the matter is tackled with method and vigor. Fortunately, when it was decided at Whitehall to take this work in hand, there was a tireless worker and first-class gunnery expert holding the appointment of Director of Naval Ordnance and Torpedoes. This officer was Rear-Admiral Sir John Jellicoe, the present Controller of the Navy, and he and his staff work indefatigably during a period of three years to push forward the work of re-sighting naval guns. Sir John's successor, Captain Bacon, R. N., has not been less energetic, with the result that to-day the guns of our fleet are better sighted, from top to bottom, than any other naval guns in the world. The work has ranged from the 12-inch guns in the turrets of the battle-ships, down to the 6-pounder guns of the destroyers and torpedo-boats of the later designs; and telescope sighting gear has been everywhere installed, without the ordinary work of the ships having been in any way interfered with. The work has been done by ships' artificers wherever possible, or while the ships and boats have been laid up for repairs and refit in H. M.'s dockyards. It is doubtful if a larger task was ever more expeditiously carried through.—*United Service Gazette.*

Instances having occurred during recent fleet exercises at night with all lights masked, in which the presence of ships has been revealed to the attacking torpedo craft by the door of the lighted wireless telegraphy room being opened, thus emitting a glare distinguishable at a considerable distance, the Admiralty have ordered that ships with their wireless room on the upper deck are to be fitted with an electrical device, so that on the first motion of opening the door all the lights within will be extinguished.—*United Service Gazette.*

PHYSICAL TRAINING.—The Admiralty announce that short courses of instruction in physical training for naval lieutenants will commence at Portsmouth on March 6.—*Army and Navy Gazette.*

NAVAL WAR COURSES.—We have frequently, of late, spoken in terms of praise of the progressive methods followed by the Lords of the Admiralty, and particularly in regard to the education and training of the *personnel* of the navy, which has been considerably advanced during the last couple of years. The establishment of war courses was an admirable idea, while their still more recent extension reflects the greatest possible credit on the naval authorities. These observations are educed by a perusal of the very instructive and very practical program of lectures and war games that has been formulated from the Admiralty, for the benefit of those officers who are desirous of presenting themselves for the winter war courses at the several dockyards. The war games will play a very prominent part in this year's lessons, provision having been made for competent instructors who will initiate the officers into a right knowledge of the games before they are permitted to take any part in them. The subjects to be dealt with cover a very wide field and will include battle practice, torpedo warfare, the Trafalgar campaign, types of warships, control of fire, turbines, international law, tactics, producer gas engine, phases of the Russo-Japanese war, and several other subjects of naval importance. The lecturers on the various subjects will be Admiral Lowry, Commanders Waistall, and Loxley, Engineer-Commander Baldwin, Lieutenants Arnold-Forster and Longden, R. N., Mr. J. S. Corbett, and the Rev. T. J. Lawrence. When we compare this very advanced program with the listless methods of the naval authorities less than a decade ago, we cannot but admit that the present Admiralty are doing great things to introduce higher efficiency into the fleet.—*United Service Gazette.*

LOSS OF ANCHORS.—The attention of the Admiralty having been called to a somewhat frequent loss of anchors by ships of war, notable instances recently being that of the *Drake*, which returned to port with two missing, and the *Essex*, which lost another when leaving Portsmouth harbor to make room for the *Drake*, the naval authorities have issued stringent orders to prevent such mishaps. It was regarded as in some degree a censure or punishment when the *Essex* was ordered to make search for the missing gear herself, instead of dockyard tugs being sent out as usual; but now the Admiralty have gone a step further, and have ordered that the evolution of mooring against time is to be discontinued. The practice, it was stated, is a very useful one as a precaution in case of emergency, but it had to some extent come to be looked upon as a sort of competition, with the result that heavy ships on the move, being brought up with a jerk caused an undue amount of strain on chain cables, resulting in some cases in the anchor being carried away. More care in working the tackle is now enjoined.—*United Service Gazette.*

THE NAVAL VISIT TO SOUTH AFRICA.—Mr. Bellairs asked the Under Secretary for the Colonies, on the 25th ult., whether he was aware of the official character of the visit of a squadron of armored cruisers to South Africa; and whether he was able to state to the House the terms of the farewell message of the admiral commanding to the British Colonies of South Africa.

Colonel Seely replied that he was not aware of the force attached to the word "official," but a visit of a squadron of armored cruisers could not in any sense be regarded as unofficial. No official report had been received of the farewell remarks alleged to have been made.

Mr. R. Harcourt: May I ask whether it is the case that Sir Percy Scott said that the kindness and hospitality of the South Africans in height equalled the top of Natal's Cassatogel's Nest, in depth rivalled the deepest mines of the Transvaal, in breadth were as boundless as the rolling plains of Orange River Colony, and in stability were comparable to Cape Colony's majestic Table Mountain?

Colonel Seely: We have no official information. If Sir Percy Scott did say that, I do not see that we have any cause to complain.—*Army and Navy Gazette.*

THE HEALTH OF THE NAVY.—Satisfactory as was the report on the health of the navy for the year 1906, the report for 1907, just issued by the Admiralty, shows that there is a still further improvement, not the least being that the average loss of service for each person has dropped to 10.46 days. The total force dealt with during the year 1907 was 108,740, and of these the total number of cases of disease and injury entered on the sick list was 75,351, which is in the ratio of 692.94 per 1000, showing a decrease of 85.23 per 1000, as compared with the average ratio of the last five years. The number of entries per man for disease and injuries was—on the Home Station, .66; Channel, .57; Atlantic, .66; Mediterranean, .68; North America and West Indies with Fourth Cruiser Squadron, .96; China, .98; East Indies, 1.03; Australia, .85; Cape of Good Hope, .71; and irregular list, .97. For the total force the average is .69, a fractional decrease on last year's figures.

The average number of men sick daily was 3118.4, giving a ratio of 28.67 per 1000, a decrease of 3.52 per 1000, in comparison with the last five years' ratio. The total number of days of sickness on board and in hospital was 1,138,219, which represents an average loss of service of 10.46 for each person, which is a decrease of 1.29 in comparison with the average for the last five years. The ratio per 1000 of men sick daily on the various stations was—on the Home Station, 30.44; Channel, 22.17; Atlantic, 24.51; Mediterranean, 25.22; North America and West Indies with Fourth Cruiser Squadron, 28.49; China, 33.34; East Indies, 30.08; Australia, 31.36; Cape of Good Hope, 25.57; and irregular list, 48.40. As was the case during the last two years, the Channel shows the lowest, and the irregular list, the highest sick ratio. The total number of persons invalided was 2322, which gives a ratio of 21.35 per 1000, showing a decrease of 3.18 per 1000, in comparison with the average ratio for the last five years. In this total are included men who were only temporarily invalided from foreign stations, many of whom are again able to rejoin the active force. The number finally invalided from the service was 1963, and this number represents the actual waste of the service from invaliding, during the year. The ratio per 1000 of final invalids was 18.05, or 84.53 per cent of the total number invalided, showing an increase of 1.12 per 1000 when contrasted with the average for the last five years. It will be noticed that in comparison with 1906, Home Station, Channel, East Indies, Australia, Cape of Good Hope, and irregular list show an increased temporary invaliding ratio; while Atlantic, Mediterranean, North America and West Indies, and China, show a decreased ratio.

The total number of deaths was 365, giving a ratio of 3.35 per 1000, showing a decrease of 1.05 in comparison with the average ratio for the last five years. Of this number 246, or 2.26 per 1000, were due to disease, and 119, a ratio of 1.09 per 1000, to injury. In comparison with the death ratios for 1906, the returns from China, Australia, and irregular list show an increased ratio; while from Home Station, Channel, Atlantic, Mediterranean, North America and West Indies, East Indies, and Cape of Good Hope there is a decreased ratio. The decrease in cases of Malta fever is remarkable, and bears striking testimony to the decline of this disease since the Medical Commission discovered that goat's milk was the principal source of infection. Only 29 cases are recorded, with five final invalidings and two deaths. In comparison with the average ratios for the last five years, the case ratio has fallen from 3.47 per 1000 to .26, the final invaliding from .13 to .04 per 1000, and the death ratio from .06 to .01. These figures speak for themselves. The Mediterranean gave 14 cases; Home Station, 10; Channel, Atlantic, North America, China, and Australia, one case each. The origin, in every instance, was traced, however, to the Mediterranean.

Yellow fever made its appearance in the fleet last year for the first time since 1904. Seven cases are returned from North America and West Indies, of which three proved fatal. It is a matter for congratulation that attacks from malarial fevers appear to be on the decline. Three hundred and

seventy-one cases are returned, but with only one death. The case ratio under this heading was 3.41 per 1000, in comparison with 6.71, the average ratio for the last five years. This reduction is greatly due to the withdrawal of ships from malarial districts on foreign stations, but partly also to the careful use of mosquito curtains, and of quinine as a prophylactic by ships serving in such districts. East Indies returned the largest number of cases —one hundred and fifteen—and by far the highest case ratio, 61.82 per 1000. The same ratio from other stations ranged from 17.69 on the China, to .52 per 1000 on the Channel. Of Dengue fever only 85 cases are recorded, China returning 41, Australia 38, and irregular list 6 cases. No cases are reported from East Indies, where, at one time, the disease was very prevalent, and particularly in seaport towns. It is a matter for regret to find that the number of cases of suicide has increased, although the increase is but slight. Nineteen deaths from suicide are reported during the year; this gives a ratio of .17 per 1000, which is a fractional increase in comparison with the average ratio for the last five years. The total deaths by violence in the Royal Navy during last year numbered 116, of which 34 were from wounds, fractures, etc., one from wounds received in action, five from burns and scalds, 57 from drowning, and the 19 suicides referred to above. Heat-stroke, though classed as a general injury, is not included among the deaths by violence, though it was answerable for three deaths during the year.

The report shows a very satisfactory state of affairs generally, the majority of case ratios showing a decline in comparison with the last five years' ratios, the only noticeable increase being in the number of venereal cases. As regards the latter, Australia again shows the highest case ratio. Sydney still has an unenviable notoriety, both as regards the number of cases contracted and the especially virulent type of the disease there. The report concludes with an interesting account of some analyses of air taken in the double bottoms of iron ships, by Staff-Surgeon Oswald Rees, R. N. It was reassuring to find that, even in the worst cases, there would not have been the least danger to life from the composition of the air. Experiments were carried out with a view to elucidate the factors which have the greatest effect in the removal of the oxygen from the air, and the conclusions to be drawn from them are, that the condition which conduces to the greatest degree of the absorption of oxygen is the combination of dampness and the presence of organic matter; and that if the compartment is dry and the surface well protected with paint, there is the least change in the composition of the air. In every case tests for other gases than the above were made, but there was no indication of any being present.—*United Service Gazette.*

ITALY.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battle-ships.			
Roma	12,625	Gov't Yard, Spezia.	Under trial.
Napoli	12,625	" " Naples.	" "
A.	19,000	" " Castellamare.	Building.
B	19,000	.....	"
Armored Cruisers.			
San Giorgio	9,800	Gov't Yard, Castellamare.	Launched July 27, 1908.
San Marco	9,800	" "	" Dec. 22, 1908.
Pisa	9,800	Orlando Works.	" Sept. 15, 1907.
Amalfi	9,800	Odero Works.	" May 5, 1908.
B	9,800	Leghorn.	Building.

The *Napoli* has nearly completed her trials and the *Roma* began hers on December 17 last; these two ships differ slightly in masts and superstructures from the *Regina Elena* and *Vittorio Emanuele*, both of which

latter ships have now entered into service. All the vessels of this class have attained speeds of from 21.5 to 22.0 knots; their batteries are two 12-inch, twelve 8-inch and sixteen 3-inch guns.

The armored cruiser, *San Marco*, which was launched December 22 at Castellamare, is a sister of the *San Giorgio*, built also at Castellamare, now completing afloat, and of the *Amalfi*, built by the Odero firm at Genoa, and the *Pisa*, by Messrs. Orlando at Leghorn. They displace 9832 tons, and carry an armament of four 10-inch, eight 8-inch, sixteen 3-inch, and eight 1.8-inch guns. Protection is given by a water-line belt, with a maximum thickness of 8-inch, tapering to 3½-inch, with 7-inch of steel and 7-inch bulkheads to protect the citadel and gun positions. The *San Marco* is to be propelled by turbines, and will have water-tube boilers and engines of 18,000 I. H. P.—*Army and Navy Gazette.*

According to *Le Yacht*, the Italian naval authorities have finally rejected rigid adherence to the all-big-gun principle, and have decided to retain guns of medium caliber as part of the armament of battle-ships. The four new Italian battle-ships (built, building, and projected) will accordingly be armed with twelve 12-inch guns, in four turrets mounting three guns each, and eighteen 4.7-inch guns, eight mounted in secondary turrets, the other ten grouped in central battery, while sixteen 3-inch guns in a central casemate will provide for defence against torpedo-boat attacks.

EFFECT OF SMOKE-STACK HEIGHT.—An interesting experiment has just been carried out on the *Napoli* to determine the influence of smoke-stack height on the power furnished by the boilers. While her forward group of boilers retained their funnel of 22 meters height above the grate bars, the two other funnels were each shortened 7 meters. In a run from Genoa to Spezia, it was found that the forward group of boilers developed 600 horse-power more than either of the two other groups.—*Le Yacht.*

JAPAN.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battle-ships.			
Satsuma	19,200	Yokosuka.	Launched Nov. 15, 1906.
Aki	19,800	Kure.	" Apr. 15, 1907.
Huki	19,800	Yokosuka.	Building.
Armored Cruisers.			
Ibuki	14,600	Kure.	Launched Nov. 21, 1907.
Kurama	14,600	Yokosuka.	" Oct. 21, 1907.
Protected Cruiser.			
Tone	4,100	Sasebo.	" Oct. 24, 1907.

ARMAMENT OF THE AKI AND SATSUMA.—The interesting announcement comes from Tokio that the proposed armament of the new battle-ships *Aki* and *Satsuma* has undergone considerable modification and is now to be arranged as follows:

Main armament: Ten 12-inch breech-loading guns of 50-caliber length.

Secondary armament: Twenty-four quick-firers, probably ten 6-inch and fourteen 4.7-inch.

The *Aki* was launched at Kure dockyard on April 15, 1907, and the *Satsuma* at Yokosuka November 15, 1906. Their armament, as originally announced and as described in all foreign publications, was not to be of the all-big-gun-single-caliber variety, but, on the contrary, four 12-inch guns and twelve 10-inch guns. If these vessels are to carry ten 12-inch guns in their main batteries, as now seems certain, they will be in line with the latest ships of the British and other navies.

The *Satsuma* has been in the water two years and her sister a year and a half, and if the Japanese Government has only recently decided to give

them a new character of armament their completion would be delayed, since it requires some time to build and install the new batteries. Several months ago it was reported from Japan that the 11¾-inch armor plating was ready to be placed in position on the *Aki*, and that the *Satsuma* was about to receive her boilers and should be ready for sea early in 1909. If this is true, and if the announcement is also correct that these vessels are to mount ten 12-inch guns, instead of four 12-inch, then it would seem that the latter decision is not recent, because these guns should be nearly ready now if the *Satsuma* is to be commissioned in the spring. Both of these ships are contemporaries of the British *Dreadnought*. Like that vessel, they were authorized in 1905, the *Satsuma* being laid down May 15, 1905, nearly five months ahead of the *Dreadnought*, whose keel was not laid until October 5, 1905. When the keel of the *Satsuma* was laid, she was therefore the largest battle-ship projected in the world, her displacement of 19,200 tons, being 1300 tons greater than that of the *Dreadnought*. The American *Delawares* had not then been authorized, because it was not until the Naval Act of 1906 that the Navy Department was directed to submit plans for the *Delaware;* not until the Naval Act of 1907 that the *North Dakota* was authorized; and, not until mid-winter of 1907-1908 that these vessels were laid down in American yards. Hence the Japanese were pioneers in the authorization of battle-ships of greater than 19,000 tons displacement, although it seems that a long time is being occupied in getting the *Aki* and *Satsuma* into commission. This delay was certainly not attributable to slowness in the construction of the hull, because a year and five months elapsed between keel-laying and launching of the *Satsuma* and about a year and four months in the case of the *Aki*. Notwithstanding that the *Dreadnought* was not laid down until after the *Satsuma*, the latter vessel is not completed while the former has been finished, and, in commission, two full years.

Under the original Japanese decision, the *Aki* class were to have their four 12-inch guns placed in pairs in barbettes, one forward and one aft, and the 10-inch guns were to be fully protected. The Japanese guard their plans rather carefully and it is not yet known how the ten 12-inch guns will be mounted. There is no doubt that they will be arranged in pairs in five turrets, but it will be interesting to learn whether Japanese ordnance officers have recommended an arrangement similar to that of all of the British *Dreadnought* class yet launched or whether they will follow the American method of arranging the five turrets along the center line of the ship. Still another thing the ordnance experts of other navies will anticipate with interest will be whether any single pair of these Japanese guns will be so mounted as to fire over an adjacent turret. This principle is embodied in the American, German and Brazilian single-caliber ships that are now building, but has been avoided in the British *Dreadnoughts*. The latter do not look with favor upon the firing of high-powered 12-inch guns in one turret directly across the top of another turret.—*The Navy.*

RUSSIA.

VESSELS BUILDING.

Name.	Displacement.	Where Building.	Remarks.
Battle-ships.			
Emperor Paul I.....	16,900	St. Petersburg.	Launched Sept. 7, 1907.
Andrei Pervozvannui.....	16,900	"	" Oct. 20, 1906.
Evstafi	12,500	Nicolaiev.	" Oct. 1906.
Ivan Zlatoust	12,500	Sevastopol.	" May 13, 1908.
Armored Cruisers.			
Bayan.....	7,800	St. Petersburg.	Launched Aug. 15, 1907.
Pallada	7,800	"	" Nov. 10, 1906.
Protected Cruiser.			
Outchakoff	6,750	Sevastopol.	Building.

SPAIN.

There seems now to be little doubt that the contract for the reconstruction of the Spanish Navy has been definitely placed with the group of British firms which made the tender, viz., Sir W. G. Armstrong, Whitworth & Co., Limited, John Brown & Co., Limited, and Vickers, Sons & Maxim, Limited. That these firms would get it was pretty generally known, but it is satisfactory to know that the matter has at last been definitely settled. The contract, as our readers will remember, includes three heavy-armored vessels of about 15,000 tons displacement, a total of about five and a half million pounds sterling; three 350-ton destroyers, or three submarines, for £252,000; and twenty-four torpedo-boats for £1,123,000. Besides these ships, works are to be carried out at Ferrol, Cadiz, and Cartagena, at a total cost of £599,360. The whole contract thus amounts to between seven and eight million pounds.—*The Engineer.*

UNITED STATES.

VESSELS BUILDING.

No.	Name. *Battle-ships.*	Speed. Knots.	Where Building.	% of Completion Nov. 1.	% of Completion Feb. 1.
28	South Carolina	18.5	Wm. Cramp & Sons.	65.9	78.9
27	Michigan	18.5	New York Shipbl'g Co.	74.9	89.7
26	Delaware	21	Newport News.	50.3	64.1
29	North Dakota	21	Fore River.	58.8	70.6
30	Florida	20¾	Navy Yard, New York.	0.	3.3
31	Utah	20¾	New York Shipbl'g Co.	0.	3.1

LAUNCH OF THE DELAWARE.—The battle-ship Delaware was successfully launched at Newport News, Va., February 6. She was christened with a bottle of champagne, deftly smashed over her bows by Miss Anne Pennewill Cahall. As a protest to the recent prohibition crusade in Delaware, liquor dealers distributed 5000 miniature bottles of whiskey, which were smashed against the *Delaware* as she went down the ways. This was one of the oddest spectacles ever witnessed at any launching, although its good taste was criticised by many. More than eight thousand persons witnessed the launch, and cheered loudly as the big vessel slid down the ways without a hitch. The Navy Department was represented by Assistant Secretary Herbert L. Satterlee.

The *Delaware* is 510 feet in length on load water-line, 85 feet 2-inches in breadth, and her mean draft to bottom of keel at trial displacement about 27 feet. Her coal bunker capacity is 2500 tons, which is sufficient to send her at a 10-knot speed a distance of 6720 knots, or twenty-eight days' steaming. Her top speed will be twenty-one knots an hour. Provision is also made for the stowage of a large amount of oil fuel. She will have triple-expansion reciprocating engines and will require 900 men to man her. Her armament will consist of a main battery of ten 12-inch breech-loading rifles, and her secondary battery will be fourteen 5-inch rapid-fire guns, four 3-pounder saluting guns, four 1-pounder semi-automatic guns, two 3-inch field pieces and two machine guns of .30 caliber. She has two submerged torpedo-tubes.

The *Delaware* will have a displacement on trial of 20,000 tons, or 2100 tons greater than the British *Dreadnought* and 750 tons greater than Great Britain's latest vessels of that type.

The hull is protected by a water-line belt of armor 8 feet in width, whose maximum thickness is 11 inches. This belt gives effective protection to the boilers, machinery and magazine spaces. The side above the main armor belt is protected by armor 7 feet 3 inches wide and of a maximum thickness of 10 inches. Above the main casemate armor amidships, the side is protected by armor of 5 inches thickness, which affords protection to the funnels, the major portion of the secondary batteries of 5-inch guns and the hull structure.

A new feature of the *Delaware* will be the two "skeleton" masts, which are to replace the present steel tube masts with fighting tops, now in use on other vessels.

The plans for the *Delaware* were prepared by the Board of Construction in competition with plans submitted by various naval architects and shipbuilding companies and submitted to a special board, under the Presidency of the former Assistant Secretary of the Navy, T. H. Newberry, and later approved by Congress. The contract for the *Delaware* was placed August 6, 1907, at a price of $3,987,000, to be built in accordance with the Department's design for both hull and reciprocating machinery. Her keel was laid November 11, 1907.—*Army and Navy Journal* and *New York Sun*.

REPORT ON NAVAL REORGANIZATION.—On February 25, the President sent to Congress a message transmitting preliminary report of the Naval Reorganization Commission, composed of Justice William H. Moody, Judge A. W. Dayton, Paul Morton and Rear-Admirals (retired) S. B. Luce, A. T. Mahan, R. D. Evans, W. M. Folger and W. S. Cowles. The report deals with the general principles governing naval organization and is as follows:

WASHINGTON, D. C., Feb. 20, 1909.

General principles governing naval organization:

1. The office of the Secretary of the Navy being executive in character, nothing should be admitted into an organization of the department which would qualify his authority or diminish his ultimate responsibility. He has been in the past, and in the future should be, a civilian. He is the representative of the President, the constitutional commander-in-chief of the army and navy, under whose direction his authority is exercised.

2. The duties in charge of the Secretary divide under two principal heads, closely related, but generally distinct; civil and military. The civil duties embrace the provision or preparation of all the material of war. This is the function of the present bureaus.

The military duties concern the use of that material, whether in war or in such exercises as conduce to fitness for operations of war. For the direction of these military duties, no subordinate provision corresponding to the bureaus on the civil side exists in the present organization established by statute.

3. The discharge of both these classes of duty involves a multitude of activities, quite beyond the immediate personal knowledge and supervision of a single man. This necessitates a subdivision of the duties by which means the supervision of the Secretary is exerted through the medium of responsible subordinates. In this subdivision the principle of undivided responsibility, within the appointed field of subordinate supervision, should obtain, as it does in the superior office of the Secretary.

The bureau system, as now established by law for the civil activities of the department, insures for each bureau this undivided responsibility, qualified only by the authority of the Secretary, which, if exerted, does not divide the responsibility, but transfers it to the Secretary himself. Independent authority, with undivided responsibility, though in principle proper, suffers historically from intrinsic inability to co-operate where a number of such independent units are present. The marshals of the first Napoleon—especially in Spain—in the absence of the Emperor, offer a familiar illustration. The bureau system, as at present constituted by law, contains no remedy for this inherent defect.

Lack of Personal Familiarity.

4. The co-ordinating power is in the Secretary's authority, but owing to the shortness of tenure in office and to the inevitable unfamiliarity with naval conditions with which an incumbent begins, authority, though adequate in principle, is not so in effect. This inadequacy consists in lack of

personal familiarity with the subjects before him, not merely severally, but in their collective relations; in short, lack of specific knowledge and experience. The organization should provide him with such knowledge and experience, digested formally, so as to facilitate his personal acquirement.

In short, an advisory body, equipped not with advice merely, but with reasons. In order to avoid the interruption of continuity attending each new administration, entailing the recurrent temporary unfamiliarity of each new Secretary, it is expedient that this advisory body be composed of several persons; but, while this provision would insure the continuity which inheres in a corporate body (in this case continuity of knowledge and of progress), the principle of undivided responsibility would dictate that one only of them should be responsible for the advice given to the common superior—the Secretary.

5. As regards the composition of the advisory body, the principles to be regarded are two: A, the end dictates the means; B, the responsibility must be individual, in advice as well as in executive action.

A. The end is efficiency for war. The agents in war are the military naval officers. Their profession qualifies them best to pronounce upon the character of the preparations for war of every kind, including not only schemes of campaign and tactical systems, but the classes, sizes, qualities and armaments of ships of war.

What the Secretary needs, specifically and above all, is a clear understanding and firm grasp of leading military considerations. Possessed of these he may without great difficulty weigh the recommendations of his technical assistants, decide for himself and depend upon them for technical execution of that which he approves.

However constituted in detail, the advisory body should be taken entirely from the class to which belongs the conduct of war, and upon them will fall, in war, the responsibility for the use of the instruments and for the results of the measures which they recommend.

Responsible Adviser.

B. As regards individual responsibility for advice, it is suggested that the Secretary of the Navy nominate to the President the officer whom he deems best fitted to command the great fleet in case of war arising; and that this officer, irrespective of his seniority, should be head of the advisory body. He alone should be the responsible adviser of the Secretary.

The provision of a responsible adviser does not compel the Secretary to accept his advice, nor prevent him consulting whomsoever he will.

The provision suggested does not limit the authority of the Secretary; but it does provide him with the weightiest and most instructed counsel, and it lays upon the prospective commander-in-chief the solemn charge that in all he recommends he is sowing for a future which he himself may have to reap.

An essential principle in the constitution of such an advisory body is that the majority of the members should be on the active list and should go afloat at not infrequent intervals; and, specifically, the head of the body, the prospective commander-in-chief, should during the summer months take command of the concentrated battle-ship force, for maneuvers, target firing and practice of every kind. This will insure also his sustained familiarity with administrative routine of the fleet and other practical matters.

6. In the two principal classes into which the duties of the Secretary of the Navy divide, civil and military, as enunciated in Section 2, above, the word "civil" corresponds largely to the activities known as technical; and there is no reason apparent why the same principle of undivided immediate responsibility should not be realized in the Navy Department in two chief subordinates, responsible, the one for military supervision, the other for technical supervision, and for all information and advice given to the Secretary under these two heads.

It is, of course, apparent that a perfectly suitable Secretary may come

to his office with as little previous knowledge of the kind called technical as he has of military; nay, he may be perfectly efficient, and yet not acquire in his four years of office either the technical or military knowledge presumable in men whose lives have been given to the two professions. Under the most favorable conditions every superior must take decisions largely on advice, which means not accepting another's opinion blindly, but accepting statements of facts and weighing reasons.

The principle of the Secretary's ultimate individual responsibility dictates that he be at liberty to consult as many advisers as he thinks necessary; but the principle of the individual responsibility of two chief advisers, for the advice given, tends to insure the most exhaustive consideration on the part of men selected for their special competency. Careful consideration with special competency give the best guarantees for advice; and a Secretary overruling it would do so under the weightiest sense of personal responsibility.

As a matter of detail, but yet so broad in bearing as to amount to a principle, it may be noted that while the adjective "military" is somewhat narrow in application, "technical" is extensive in scope. Naval construction, ordnance and steam engineering are all technical professions.

The selection of a chief technical assistant to the Secretary might therefore be made from the recognized technical experts of the navy, under any of the three heads named, or a competent civilian engineer and naval architect may be appointed as Second Assistant Secretary of the Navy, under whom the four technical bureaus may be co-ordinated.

Success in Warfare.

7. In conclusion, it should be distinctly laid down as a cardinal principle that no scheme of naval organization can possibly be effective which does not recognize that the requirement of war is the true standard of efficiency in an administrative military system; that success in war and victory in battle can be assured only by that constant preparedness and that superior fighting efficiency which logically result from placing the control and responsibility in time of peace upon the same individuals and the same agencies that must control in time of war.

There should be no check or change of method in expanding from a state of peace to a state of war. This is not militarism; it is a simple business principle based upon the fact that success in war is the only return the people and the nation can get from the investment of many millions in the building and maintenance of a great navy.

The Commission also presented a report dated February 18 on the consolidation of navy yards, in which they say:

"The two subjects when taken together—the dispensing with unnecessary navy yards and the provision for navy yards which are required 'by strategic consideration in time of war, and for maintaining the fleet in constant readiness for war in time of peace,' are questions of such gravity and demand so much careful study that it would be impracticable for the Commission to bring in even a preliminary report of any value in the limited time available. The determination of the location of navy yards and naval bases being a question involving military and strategic considerations of the highest national importance, we venture to recommend that at the earliest practicable date this subject be referred to a joint commission of senior officers and officers of the United States Army, which will be instructed to report formally to the President."—*Army and Navy Journal.*

THE DRYDOCK AT PEARL HARBOR, HAWAII. By Elmer Murphy.—The drydock at the naval station, Pearl Harbor, Hawaii, is to be the largest ever constructed by the Navy Department. Its over-all length is 1195 feet, whereas the longest dock previously constructed, which is at Philadelphia, is 799 feet over all, and the Puget Sound drydock, recently contracted for, is 863 feet over all.

The width between coping will be 130 feet, and the depth over flue blocks at mean high water, 32½ feet. An innovation, so far as American docks are concerned, is that there will be four caisson seats, two, as usual, at the entrance to the drydock and two others near the middle of the dock, dividing the main structure into an inner and outer dock. There will be two steel caisson gates, and the arrangements will be such that, with a ship in the inner dock, the outer dock may be filled and emptied independently, thus allowing the ship upon which the most extensive repairs are to be made to remain in the inner dock, while ships with minor repairs are being docked in rapid succession in the outer dock. By floating the inner caisson from the drydock, ships of greater length than any now in existence or planned could be docked. A trapezoidal form of head has been designed for this dock, different from any hitherto considered. It is arranged so that three destroyers may be docked side by side, extending to the very head end of the dock, and leaving room for three other small craft in the inner dock.

The draft over sills at mean high water will be 35 feet, which is more than any other dock excepting the one at Puget Sound, where the great variation in tides required a draft of 38 feet. The conditions of depth at Pearl Harbor are such that the largest battle-ship may enter the dock at any stage of the tide. Concrete will be used throughout in the walls and floor. Granite lining will be used only at the caisson seats, at the coping at entrance and at the material slides. The conditions for the use of concrete are believed to be more favorable at Pearl Harbor than at any point in the United States, on account of the equable climate and absence of frost.

A marked improvement over all previous docks has been developed in connection with the dock for Pearl Harbor, in that the working floor will be absolutely level from end to end, giving a level working surface, free from the usual obstructions, such as bilge block slides, docking keel-block bearers, bilge-block chains, temporary electric wires, temporary compressed air-lines, etc. The attempt has been made many times previously to accomplish this object, but never with success. It has been accomplished in this case by an entirely new design for bilge-block bearers and docking keel-block bearers. The bearers are made in the shape of cast-iron boxes imbedded in the dock floor, with top flush with the concrete. The wide flanges on the top form the bearers for the keel blocks and bilge blocks, and a slot is provided through the top of the box to take the anchor bolts for the keel blocks and the holding-down device for the bilge blocks. The cast-iron box is large enough also to take the chains for the hauling of bilge blocks across the floor of the dock while a ship is being placed. Another most important function of the cast-iron boxes is to drain the floor. The water passes through the slots, and flows along the sloping bottom of the boxes, and is discharged into four large longitudinal sub-floor drains. These, in turn, carry the water into the drainage chambers near the middle of the dock. The inner dock and outer dock each have an independent system of longitudinal drains and a drainage chamber. Three 54-inch pipes with gate valve pass from each drainage chamber into a common wet chamber outside of the drydock structure. The four 54-inch suction pipes from the pump-well, which is close by, open into the wet chamber, thus removing water which flows in from either one or both of the drydocks. The slots, cast-iron boxes, and drains have been so designed that the velocity of water while being pumped will be sufficient to remove any silt which may have collected.

The system of cast-iron boxes with slots and longitudinal floor drains will also be used for filling the dock. Four filling culverts, two on each side of the drydock, having inlets in the quay wall at the entrance of the dock, are connected with the longitudinal drains in the inner and outer docks in such a manner that either dock may be filled independently of the other. The water will be discharged into the dock body through the

slots, having thus an upward velocity on entering and being uniformly distributed over the entire floor. This is much superior to having the water enter at the ends or sides with a velocity sufficient to cause harmful movements of the ship. Sixteen flights of stairs extend from the coping to the floor. This number is liberal, in order that the workmen may enter and leave the drydock with expedition. There will be 539 keel blocks, extending from the entrance to the head of the drydock. These are for the purpose of carrying the weight of the ship when the dock is pumped. Two lines of docking keel blocks will extend on either side of these to take the weight of turrets, etc., of battle-ships. The pump-well will be located near the middle of the dock and about 30 feet away. It will be of octagonal shape, and will contain four 54-inch pumps.

A track for a 40-ton crane will be built around the drydock structure, with the inner rail close to the edge of the coping. The total length of the rails in this track will be within a few feet of one mile. The construction of the dock will necessitate the disposal of 350,000 cubic yards of material. This will be utilized in filling some of the low areas on the station property. The depth of the excavation will be 58.5 feet. This is more than the height of an ordinary four-story building. The total amount of concrete to be used in the dock is approximately 120,000 cubic yards.—*Scientific American.*

ORDNANCE AND GUNNERY. TORPEDOES.

BATTLE PRACTICE IN THE BRITISH NAVY. By Percival Hislam.—Many important changes in the conditions governing battle practice in the British Navy come into operation this year, the aim of which is to reproduce more closely the conditions of a naval engagement. In the first place, the target, which has hitherto been moored to buoys in a fixed position, is this year to be towed at a speed of eight knots; secondly, instead of all hits being lumped together as formerly, careful note will be taken of the hits made by the various types of guns, and a larger allowance of marks will be made for bulls with heavy projectiles, the figure decreasing as the caliber of the gun diminishes. This is a much-needed reform, as it is obviously ridiculous to valuate a hit with a 6-inch shell weighing 100 pounds at the same figure as one with a 12-inch weighing 850 pounds. Thirdly, both broadsides will be brought into play, instead of only one, as was previously the case.

The introduction of these new conditions has necessitated the design of a new target, the old pattern being quite unsuited for towing. The first of the new pattern has recently been launched. In general appearance the structure resembles the hull of a ship with a huge oblong framework erected on it. This hull is constructed of steel, ballasted heavily with concrete, in order to give sufficient stability to enable the target to be towed. Its total length is 140 feet, and its depth, from keel to the level of the deck, 20 feet. Its beam amidships for the length of the target is 5 feet; but for a distance of 25 feet from either end a raised deck is built (that at the fore end having the lines of a small gunboat), and these ends are 9 feet wide.

In its completed state the target is submerged to a depth of 20 feet, leaving 31 feet exposed above the water. Over the gridiron framework, which is built throughout of 12 x 12-inch timbers, is stretched a canvas 90 feet long and 30 feet high, which forms the actual target, and which is of the same size as in previous years. The weight of the whole structure is 170 tons; the cost, $2,500; and the time required for building, six weeks. The targets are built and launched on their side, and afterward righted.

A few words as to the general conditions under which battle practice in the British Navy is carried out may not be without interest. Just before the time for firing, the ship proceeds to a sheltered harbor in order to calibrate her guns, which means the adjustment of the sights to the wear of the barrel. This, especially in the heavier weapons, becomes considerably scored by the corrosion of the powder and the passage of projectiles along

it—so much so, indeed, that after eighty or a hundred rounds have been fired from a 12-inch gun, it is necessary to reline the barrel. In calibrating, the guns are trained on a known range and fired, the fall of the shot being noted by officers stationed near the target, the gun-sights themselves having an error of only 5 yards in 3000. A number of rounds are fired, the mean of the errors taken, and the sights altered to correct the error of the gun-barrel.

The ship then proceeds to the battle-practice range with the chief umpire on board. In the possession of the navigating officer is an envelope containing a sketch of the course to be followed. This course is laid down by the umpire, and no one in the ship is acquainted with it, so that the crew are in complete ignorance both as to the range at which the firing will open and the broadside which will first be brought into action. The range varies actually between five and seven thousand yards; and as the ship approaches it on a zig-zag course, each broadside is brought into action alternately. The firing lasts for fifteen minutes.

After the firing is concluded the results are carefully noted by the umpire, who forwards them to the Admiralty. There they are worked out with the aid of a confidential formula—the actual number of rounds and hits being kept secret—and the results published as points. It is known, however, that the average of hits to rounds fired throughout the fleet runs to between 35 and 40 per cent, the best ships putting in about 65 per cent.

It is important that battle practice should not be confounded with the gun-layers' tests. The latter are carried out at ranges of 1500 to 2000 yards at a target 10 feet by 8, and the full details are published by the Admiralty. Eighty per cent of hits is now a common score in these tests, the best shooting so far having been made by a gunner of the cruiser *Argonaut* named Sparshott, who succeeded in getting off eleven rounds and scoring eleven hits in one minute with a 6-inch 100-pounder rapid-fire gun.

The question of fire-control has been receiving a good deal of the British Admiralty's attention lately. In the gunnery trials against the old battleship *Hero* last November, the fire-control communications were shot away in the first half-dozen rounds by a fragment of shell which went clean through the ship's mast, while later on a shell burst in the control top, setting fire to the dummy men which had been placed in it. Some time ago experiments were carried out with a new control system which could be installed behind armor near the water-line, but it was not successful, height being a *sine quâ non* of the control officer, who must note the fall of the shot with reference to the target. It is understood that experiments will shortly be made with a skeleton mast, similar to that which was built for the same purpose on the United States monitor *Florida*.—*Scientific American*.

SHOOTING IN THE NAVY.—The three blue-books, entitled, respectively, "Result of Test of Gunlayers with Heavy Guns," "Result of Test of Gunlayers with Light Q. F. Guns," and "Result of Battle Practice with Torpedo-Boat Destroyers," for the year 1908 have been issued. In each of these there is again to be noticed a decided improvement in the shooting of all arms.

Following the method which we employed last year in dealing with these books, we will take the heavy guns first. In 1908, 117 ships fired in the trials and 1277 guns were employed, these figures comparing with 121 and 1365, respectively, in 1907. The results obtained in these two years are as set out in the accompanying table:

	1907.	1908.
Number of hits	4073	4826
Number of misses	5455	4183
Total rounds	9538	9009
Percentage of hits to rounds fired	42.70	53.57

A new size of target was used in these operations in 1907 for the first time, and, consequently, it is rather difficult to compare the present year with those prior to 1907. We may say, however, that the 1907 target was considerably smaller than that used prior to that date.

In 1907 the percentage of hits to rounds fired worked out to 79.13 on the earlier and larger target, and 42.70 on the 1907 target. The 53.57 per cent of hits obtained last year on the smaller target would probably represent over 90 per cent of hits on the earlier and larger target, and is a figure which is, in any case, nearly 25½ per cent better than that reached in 1907, though that year was a great deal better than those which had gone before. There is good ground, therefore, for the satisfaction with which the Lords of the Admiralty note "further improvement in the results as compared with those obtained in 1907, when the shooting showed an advance over previous years." As a matter of fact, with the exception of the year 1904, when there was a falling off of something over 3 per cent—which was much more than counterbalanced by an improvement of nearly 14 per cent in 1905—there has been an increase year by year in the efficiency of the shooting with big guns in the navy ever since the year 1899, and of recent years this increase has assumed greater and greater proportions.

An advance has also taken place in the number of hits per gun per minute, as is shown in the following table, which compares the results of 1907 and 1908 on the smaller target brought into use in the former year:

	Hits per gun per minute.	
	1907.	1908.
12-inch and 10-inch	0.40	0.56
9.2-inch	2.01	2.20
7.5-inch	1.58	2.51
6-inch Q. F. and B. L.	3.32	3.98
4.7-inch and 4-inch Q. F.	2.38	3.32

It will be observed that with every size of gun there has been an improvement. In fact, the year 1908 showed better all-around shooting with guns down to 4-inch than had been achieved in any of the ten preceding years.

The same tale may be told regarding the results of the tests with light quick-firing guns. This will be appreciated, as the percentage of hits to rounds fired was nearly two-and-a-quarter times as large as it was in 1905, only four years ago.

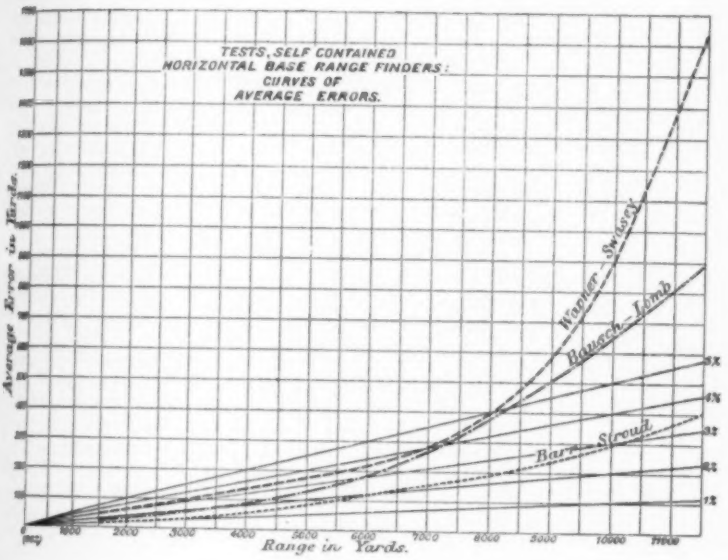
A still greater improvement is recorded as a result of battle practice from torpedo-boat destroyers. The comparison of the above table with that which follows is all the more interesting in that, to a large extent, the sizes of the guns used were the same; in fact, the advantage is with the torpedo-boats, as the smallest gun used in the tests with them was the 6-pounder. The following table gives the figures for the four years 1905, 1906, 1907, and 1908:

	1905.	1906.	1907.	1908.
Number of ships that fired	57	52	121	139
" " guns	342	312	669	701
" " hits	653	1004	2069	4066
" " misses	2608	1898	3709	2906
Percentage of hits to rounds fired	20.02	34.60	35.81	58.32
Hits per gun per minute:				
12-pounder, 12 cwt.	1.54	2.43	3.97	7.44
12-pounder, 8 cwt.	—	—	—	5.41
6-pounder	1.98	3.73	3.57	7.12

There are several points worthy of attention in this table. The first is the large increase in the percentage of hits to rounds fired. The year 1907 showed but a small improvement on the year 1906, but in 1908 the percent-

age of hits to rounds fired reached the remarkable figure of 58.32 per cent, as compared with 35.81 in 1907. Another significant fact is the increase in the number of hits per gun per minute, both with the 12-pounder 12 cwt. guns and with the 6-pounders.—*The Engineer.*

RANGE-FINDER TESTS IN AMERICA.—In view of the articles upon short-base range-finders which have recently appeared in our columns, the results of some exhaustive tests of instruments of this class, recently carried out by the United States Artillery Board, will be of considerable interest to our readers. The object of the tests was to determine the best self-contained range-finder for use on low sites, with a view to its adoption as a standard instrument by the United States Army. A very broad specification of the desirable features was drawn up, but it was distinctly stated that the test was to select the best possible instrument of this kind for the service, and that any means whereby this end could be effected would be considered by the Board.



Three firms entered for the competition—namely, Messrs. Barr & Stroud, of Glasgow; Messrs. Bausch, Lomb & Saegmuller, of New York, and Messrs. Warner & Swasey, of Cleveland, Ohio. Messrs. Barr & Stroud submitted a standard 9-foot range-finder which they had in America at the time, and which was accepted for trial, although not conforming to the specification in minor details. The Bausch, Lomb & Saegmuller Company were represented by three instruments made in Germany, of which only one, a 2½ meter instrument, was used till the end of the tests. The range-finder of Messrs. Warner & Swasey was 9 feet in length. All the three were on the "coincidence principle." The various makers were asked to have representatives present throughout the trials, who should make some of the observations with their respective instruments, and certify at the conclusion of the experiments their satisfaction with the tests.

Nothing could have been fairer than the conditions laid down, and, in fact, Messrs. Barr & Stroud showed their confidence, both in the trials and

in their instrument, by excusing themselves from having a representative present, and certifying in advance their acceptance of the decisions of the Army Board. The trials lasted a fortnight, very large numbers of observations being taken with each instrument under various conditions of fixed and moving objects, daylight, night, etc. The ranges were generally up to 9000 yards, which is near the useful limits of such instruments, but observations were also made up to 11,500 yards, or over six miles. Every care was taken to eliminate the personal equation by averaging the readings of many observers, composed of soldiers, officers and the manufacturers' representatives. We regret that we have no space to reproduce the complete results in detail, but they are to be found in the current number, Vol. XXX. No. 3, of the *Journal of the United States Artillery*. They occupy many pages of the journal in question, and show an overwhelming superiority of the Barr & Stroud instrument over its competitors. The appended diagram, which we take from the same publication, demonstrates this with equal force. It is a case of "one first and the rest nowhere" for all ranges over about 6000 yards. At this range the Barr & Stroud range-finder gave, as the curves show, the distance of the object correctly within 2 per cent. This means an uncertainty of only 120 yards in the range of an object nearly three and a half miles away. The next best instrument was 180 yards out, or 50 per cent more inaccurate.

At greater distances the superiority of the British instrument became even more strongly marked. At 10,000 yards, or nearly 5¾ miles, its error was well under 300 yards, while its nearest competitor was 650 yards out in the same distance, and the American instrument was 900 yards out. The Barr & Stroud instrument maintained a wonderfully constant correctness right up to the extreme distance tests. Looked at purely as a piece of optical and mechanical work, it is really extraordinary that the apex of an isosceles triangle, having a three-yard base, and sides six miles long, can be located within 3½ per cent. This is what the range-finder does, however, and it is, moreover, perfectly efficient in the hands of a person who has never seen such a thing before. With all its precision, it is not delicate, and will withstand very considerable rough treatment without damage.

As could only be expected from the results of the tests, the United States Army Board recommend "the adoption of the Barr & Stroud self-contained horizontal base range-finder as the standard range-finder for rapid-fire guns, and the emergency range-finder for direct-fire guns of the primary armament on low sites, and for use at battle and fire-commander's stations on low sites" provided certain minor modifications are made.—*Engineering*.

LUMINOUS PROJECTILES.—It is proposed to substitute for searchlights on warships, guns firing projectiles which will emit intense light, either during their flight through the air or on striking the water. The short duration of the flight, however, appears to make the first method impracticable. For the production of light on striking the water calcium carbide is the most suitable substance, as on contact with water, it generates acetylene gas which, when ignited, produces a very intense light. The latest form of acetylene or carbide bomb comprises two cylindrical wooden shells, which telescope together. The inner shell is filled with calcium carbide, calcium phosphide, and gunpowder, not mixed together. It has an iron head and, at its opposite end, an orifice for the escape of gas.

The two wooden cylinders separate immediately on leaving the muzzle of the gun and the inner cylinder continues its flight alone. On striking the water the projectile, after the first plunge, rises to the surface. Water enters the shell and evolves acetylene from the carbide, and hydrogen phosphide or phosphureted hydrogen from the calcium phosphide. The hydrogen phosphide ignites spontaneously on contact with the air and sets fire to the acetylene. The flame is not extinguished, but rather brightened,

by contact with water, so that an intense light is produced even in a high sea. An intensity of 2000 candles and a life of three hours are claimed for these acetylene bombs, and they can be projected to distances of two miles or more. Yet they form very incomplete substitutes for searchlights. They are of little use in the search for hostile torpedo-boats because they are useful only when the position of the object to be illuminated is already approximately known. Even in such a case a torpedo-boat could easily escape from the area illuminated by the bomb before it could be hit by the enemy's guns.—Prometheus.—*Scientific American.*

GRAPHITE IN POWDER.—Efforts are progressing on both sides of the Atlantic toward the development of powders which will be more stable and less serious in their eroding effect upon guns. Captain Monni of the Royal Italian Navy has been giving very serious study to the advanatges attending the experimental addition of carbon to smokeless powder. His argument is based on the fact that the carbonic acid gas produced by the explosion takes from the steel of the gun the carbon necessary to form itself into carbonic acid, thereby giving rise to erosion. Captain Monni proposes, therefore, to supply the necessary carbon by adding charcoal to the smokeless powder during its manufacture. Thus transformed, the smokeless powder is declared to burn at a much lower temperature.

Captain Monni asserts that his experiments have confirmed his theory, by showing a smaller degree of erosion in the guns used in the experiments. It is understood that it is necessary in his scheme to increase the charge only slightly to compensate for the decrease in the temperature of the explosion and the comparatively great decrease in the volume of explosion gas produced. In some cases the proportion of carbon added has been as much as 19 per cent of the weight of the smokeless powder.—*United Service Gazette.*

Metal fouling has become a greater nuisance with the 1906 ammunition than ever before. The use of very fine graphite is recommended as a preventive. It may be used by applying to the bore of the rifle by means of a rag on the end of a cleaning rod. Sperm oil may be used with the graphite if the latter is too dry to adhere to the bore. Another method of using the graphite is to put a small quantity in the shell with the powder, so that after each discharge a coating of graphite is left in the barrel.

In a test of graphited ammunition made at the Springfield armory, 3600 cartridges were opened, the bullets graphited with Acheson No. 1340 graphite and returned to the cartridge cases. The bullets were knurled by rolling them under a file and then rolled in graphite between two blocks of soft wood.

After firing 3600 rounds no signs of metal fouling were visible.—*Arms and the Man.*

A number of experiments with new torpedoes are being carried out under instructions issued by Captain Reginald H. S. Bacon, Director of Naval Ordnance. The battle-ship *Hibernia* is conducting, from Torbay, tests with the new Whitehead torpedo, which can be discharged with accuracy when a vessel is traveling at very high speed. The new Hardcastle torpedo, in which increased speed and radius are the new factors, is also to be tried again, as well as new tubes. Its range is 7000 yards at 31 knots. A torpedo is also being manufactured which can travel 1000 yards at 42 knots, and 5000 yards at 21 knots, this being our present best. In comparison the German type has a range of 4000 yards at 21 knots, and the V. S. A. pattern 4000 yards at 27 knots.—*United Service Gazette.*

The statement that decisive experiments are about to be made with the new projectile and cartridge for the Austro-Hungarian military rifle, is confirmed. Like the new projectiles in the French and German armies,

the new Austro-Hungarian bullet is pointed not ogival. It contains a steel needle in the center of the leaden kernel, and is cased in nickel-steel. The initial velocity is 900 meters per second. The projectile, which is 28 millimeters long, has a flat trajectory for more than 700 meters, and penetrates at 1000 meters all infantry shields hitherto invented. The new cartridge will necessitate the re-sighting of the infantry rifle. Forthcoming experiments are intended to decide the best powder for the projectile. Nitroglycerine powders give greater initial velocities with considerable recoil, and corrode the barrel. Cellulose powders, on the contrary, give lower velocities and less recoil, and preserve the barrel.—*United Service Gazette.*

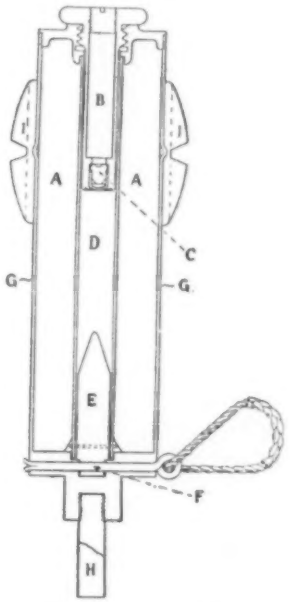
The Department of Naval Ordnance has adhered to hydraulic mountings for large guns for so long that the gun trials of the *Invincible*, which alone of the class is fitted with electrical turrets were of special interest. The only other British-built warship that has been built for some years with electrical training, loading and elevating gear for the primary armament is the *Rurik*, whose builders, Messrs. Vickers, supplied two of the *Invincible's* turrets, the other two being made at Elswick. The trials, which were carried out last month, were inconclusive as regard future policy, and while some hitches occurred owing to the unfamiliarity on the part of the staff of the *Excellent* with the new mountings, the general result was quite satisfactory. Both French and American navies used electrical mountings for many years. If the difficulty of absolute control under all conditions can be entirely surmounted it is probable that many more turrets of the new type will be fitted, in spite of the fact that the present naval opinion is against electrical equipment on the grounds that hydraulic gear gives more trustworthy and suitable means of working.—*The Engineer.*

A NEW RIFLE-PROPELLED GRENADE.—Some interesting tests and experiments have been carried out in England with a new type of rifle grenade that has been recently invented by Mr. F. Marten Hale. This new missile was suggested to the inventor by the success that attended the use of hand-thrown grenades by the Japanese outside Port Arthur and in Manchuria for trench storming. In order to render such an arm of even greater utility and efficiency, he embarked upon a series of experiments toward the projection of the missile by means of the ordinary rifle. It is possible by such weapon to discharge a shell from a protected position several hundred feet from the assaulted point, without any attendant exposure.

The accompanying illustrations will convey an idea of this new arm in use. In general appearance it resembles the ordinary pyrotechnic rocket with the head and tailpiece. The head or body is about 5½ inches in length by approximately 1¾ inches in diameter, made of stout brass tube. Into the bottom of the tube is screwed the tailpiece, which is about 9 inches long and which slides into the barrel of the rifle. The total weight of the grenade is approximately 22 ounces.

The central space of the casing *G* is hollow, and carries a tube *D*. Into the upper end of this tube is inserted the detonator *B*, secured in position by a milled head-nut. To the lower end of the detonator is attached the cap and anvil *C*, by means of which it is fired. The detonator itself is carried apart from the grenade in transport for safety, so that inadvertent explosion is impossible. The lower part of the hollow tube *D* carries the brass striker *E*, which, though sliding within the tube, is held in its position and prevented from creeping toward the detonator *B* during flight by the copper shearing wire shown. When the head of the grenade strikes the target this striker is released under the force of the impact, falls on the cap of the anvil *C*, and fires the detonator and the explosive charge *A*, carried in the annular space between the central hollow tube and the outer casing *G*. Passing through the base of the striker *E* is a copper safety pin with a cord loop attached. After the grenade has been fixed

in the rifle barrel ready for discharge, the soldier gives the cord loop a pull, thus drawing out the safety pin, so that the striker is held in position by the copper shearing wire, as already described. The steel rod *H* fits closely in the barrel of the rifle, and also acts as tailpiece and balance to the grenade during its flight; moreover, it plays an important part in its propulsion. Around the external surface of the grenade casing, near the head, the steel shrapnel ring or weight *I*, serrated into 24 parts, is carried, which when the charge explodes, bursts into fragments flying in all directions. The explosive used is "tonite," equal to No. 1 dynamite. It embodies most of the high-explosive properties of compressed guncotton with the advantage that it can be exploded by an ordinary detonator without the use of dry primers. The explosive charge of the grenade weighs about 4 ounces.



SECTION THROUGH THE RIFLE-PROPELLED GRENADE.

With the elevation of the rifle at an angle of 30 degrees and using the British Government blank cordite cartridge, the grenade can be thrown 450 feet. When a cartridge having a cordite charge of 45 grains instead of the regulation weight of 31.5 grains was used, the grenade was thrown 900 feet. The augmentation of the powder charge by approximately 50 per cent was found to inflict no ill effects upon the rifle, and ball cartridge could subsequently be used therewith with perfect success.

In carrying out experiments with the weapon, a hillock or mound was selected about 40 feet square and 10 feet in height, affording just such cover as that which an attacking party would use in a strategical forward movement upon a position. From the rear of this ridge a number of grenades were fired over the hillock, the range being such that they fell on low ground under the shelter of the opposite side of the ridge. The grenades fell and exploded with terrible effect, a large hole being torn in the ground where each grenade had struck the earth and exploded, while the frag-

ments of the serrated weight ring were found scattered in all directions over a wide area.

For the purpose of demonstrating the havoc that would be wrought in this manner, a number of screens of brown paper measuring 6 feet in height by 8 feet in length, were erected in the vicinity of the spot where the missiles fell. These were either blown down by the force of the concussion or torn to shreds and riddled by the flying fragments. In another test a pit was prepared, 6½ feet deep by 8 feet long and 3½ feet wide. It was lined with 12 inches of concrete covered by 1-inch planking. The top of the pit was closed with nine heavy timber balks measuring 4½ feet

A GRENADE WHICH IS HURLED BY A RIFLE AND EXPLODED AT THE TARGET.

long by 10 inches wide and 5 inches thick. A grenade was then dropped into this pit by suitable means. The resultant explosion hurled the top timber balks bodily into the air for several feet, and threw them on one side. Subsequent examination of the walls of the pit showed them to have been easily penetrated and the concrete backing extensively damaged and pitted. Altogether, 19 out of the 24 fragments of the ring encircling the grenade were recovered, the average weight of each of which was 9 grams, while other pieces, numbering 31 in all, were picked up from behind the planking which they had pierced, the total weight of the fragments secured being 157 grams, the largest piece of which weighed 10.3 grams and the smallest 0.22 gram. The extent of the fragmentation together with the ease with which the 1-inch planking had been pierced, even by small pieces only weighing 0.22 gram, combined with the violence with which

the timber ball covering the pit were thrown into the air, testifies to the death-dealing potency of this new invention.

Though so widely and terribly destructive in itself, the grenade is perfectly harmless unless detonated. In the course of an action, should a grenade be pierced by a bullet, the result would be quite negative. Convincing proof of this was shown by firing ball point blank at the grenade. The bullet simply pierced the casing and smashed the explosive charge, not the slighest detonation or explosion of the charge resulting.—*Scientific American.*

THE EXPERIMENTAL FIRINGS AT THE "JÉNA."—As is well known, the *Jéna* is shortly to be fired at experimentally. The Minister of Marine on February 1, approved the program of firings drawn up by a special board, presided over by Admiral Auvert.

These experiments have the double object of determining the value of different kinds of projectiles and the best form of protection. It has, therefore, been necessary to specify both the kind and caliber of each projectile and the part of the target where it should hit.

The firing will probably be done from the shore. It would be a delicate matter, in fact, to fire shell charged with melinite from a ship, where the personnel could not be sheltered from the effects of a premature explosion, and where, moreover, the extreme accuracy needed to hit with each shell the exact spot chosen for it requires a steadiness of platform not easily obtainable with a ship.

The tests will be made in two series. The first, at short range and with reduced charges, to definitely determine the effects of the explosion of shell striking at selected points; the second, at fighting range and with full charges, to verify the ballistic formulæ and the formulæ for armor penetration.

Steel shells will be fired, the cast-iron shell having been virtually condemned.

Various designs of steel shell loaded with melinite will be tested, some such as are in store, others which are experimental.

Our artillery does not possess any of those famous shells of great capacity, those "portmanteaus" of explosive which, according to some, and especially according to the Russian Commander Semenof, were used by the Japanese at Tsushima. It is difficult to realize a shell with thin walls and great chamber volume capable of withstanding the pressures used in naval guns, but our naval ordnance people will try to determine the shell of greatest capacity practicable.

Does the sort of shell described by Semenof actually exist, for that matter? Were they not really lyddite shells charged with 10 per cent of their weight of picric acid and similar to our cast-iron shell loaded with melinite? One thing is certain, and that is that the Japanese lyddite shell behaved very well, while ours do not, and that it is urgently necessary either to alter those that we have or to find something else to replace them.

In the course of the experiments there will likewise be ascertained the physiological effects upon the personnel; it is an important question because of certain Russian statements which depict the crews at Tsushima as knocked out by breathing the poisonous gases produced by explosions. It is upon these affirmations that the theory is based of bombardment with carbon dioxide, a theory which, although very doubtful and already partly destroyed by the experiments with the P shell against the *Duperré*, has need of being either verified or completely disproved.

Ventilators are to be operated on the *Jéna* so as to produce the same interior circulation of air as if the regular machinery was in use. Animals will be placed in the different compartments, below the protective deck and in the turrets; if poisonous gases are drawn in and spread through the interior of the ship to a dangerous extent, they will perish. Finally, microphones will be secured over the hearts of some of these animals so that the

instantaneous effects which the explosions produce upon their organisms can be observed from a distance.

It has been said that in the real firings of battle perforations of armor have not been found to occur. As the shell, theoretically, under many circumstances should perforate the armor, must we conclude that the results of proving ground tests are inexact? It is essential to overcome this objection in order to justify the design of our new patterns of shell, which are supposed to act by perforation of armor. But for a logical study it is necessary to hit at the exact points chosen in advance, and this is only possible at short range, using charges which give striking velocities corresponding to those which would be obtained in firings at long range.

This first series of tests finished, it will remain to determine that the shell behave identically in the same manner when fired with full charges at long range or at short range, with charges calculated by formulæ. This will be the object of a second series of firings, at long range.—*Le Yacht.*

WIRELESS COMMUNICATION.

PROGRESS OF RADIO-TELEPHONY. By Lee De Forest.—While the installation of radio-telephone apparatus on 26 ships of the United States Navy, prior to their "Round-the-World" cruise, demonstrated the great utility of wireless telephone communication for inter-fleet work, it also demonstrated the necessity for making this apparatus more nearly automatic, to put it into the hands of unskilled operators, or whoever wished to use the instruments.

Lessons were learned from these installations which no amount of theory or laboratory experiment could have taught. Following upon reports of the engineers who went with the fleet to Trinidad, the aforementioned improvements were developed and were installed upon the fleet when it arrived at San Francisco, and on its way to Honolulu. Reports from the latter point as well as those received from Western Australia indicate that the radio-telephone service has been rendered much more efficient by those automatic adjuncts.

About the same time the improved apparatus was demonstrated before the French Government at the Eiffel Tower station. Using the small antenna similar to those on shipboard, voice communication was maintained from Paris to Melun, 60 km. (36 miles), and later at Marseilles, 130 km. (80 miles). During two nights, when the high antenna on the Eiffel Tower was in use, it was reported by the French Government wireless operator at the Mediterranean station near Marseilles, that gramophone music was heard over that distance, approximately 550 miles.

Following these demonstrations in Paris, the French naval officers, especially Lieutenants Colin and Mercedier, continued experimenting with apparatus which they built following the De Forest designs, and have since reported very satisfactory results from Eiffel Tower to Dieppe, 150 km. (93 miles).

The Italian Government purchased four sets of radio-telephone apparatus for marine work, which the writer installed at Spezia last May.

The apparatus has been still further improved during the last summer, and in September, at the request of the British Admiralty, an official demonstration was made between H. M. S. *Furious* and *Vernon* at Portsmouth, England. During these tests perfectly clear and accurate voice communication was maintained up to a distance of 60 English miles, although this was by no means the limit attainable with these instruments on shipboard. As a test of accuracy during these tests, long lists of numerals were read into the transmitter on board the *Furious* and written down at the receiving station on the *Vernon*. A comparison of these figures, e. g., at the distance of 44 miles, shows an accuracy of 98 per cent.

Further development and refinement has progressed since the Admiralty

installation. The apparatus is being continually simplified and its range increased, so that it is now fair to say that the radio-telephone is to-day applicable to a large number of vessels which cannot afford to carry a Morse operator, and which will be content with 100-mile communication.

Significant of large development in the near future is the fact that a contract has been made with the Metropolitan Life Insurance Company for the use of its new tower (680 feet high) as a wireless telephone and telegraph station. This will give the tallest antenna of the world, except that at Eiffel Tower, and it is reasonable to expect some long-distance records from this station during the coming year.—*Electrical World.*

NAVY LONG-DISTANCE WIRELESS PLANT.—On January 5 proposals for furnishing long-distance wireless plants for the navy were opened, consisting of a sending station at Washington, having a range of 3000 miles, and two equipments for vessels having a receiving range of 3000 miles and a transmitting range of 1000 miles. The circular for prospective bidders is a formidable document which, if taken too seriously, might well deter any manufacturer from submitting a proposal. Aside from forms, there are 33 paragraphs, of which 31 consist mainly of conditions to secure the government from any possible loss, or exercise of any generosity toward a manufacturer who might, in his zeal to meet the need by the government for such a plant, too lightly pass over the difficulties incident to its design and construction—these precautions recalling the interesting game of "Heads I win, tails you lose." Apparently exhausted in the work of preparing these safeguards, the writer of the document confines to two paragraphs the specifications to guide the successful bidder, as follows:

"The station to be capable of transmitting messages at all times and at all seasons to a radius of 3000 miles in any navigable direction from Washington, D. C. Such messages must not be interrupted by atmospheric disturbances, or intentional or unintentional interference by neighboring stations. The station to be capable of transmitting and receiving messages with entire secrecy. The contractor must supply the necessary concrete buildings, with living accomodations for four operators, towers, ground connections, wiring and apparatus complete. Such to be erected at or near Washington, D. C., the exact location to be decided at a later date.

"Two sets of apparatus installed on board vessels of the United States Navy, to be capable of transmitting and receiving messages at all times, in all seasons and in all latitudes, to and from a distance of 1000 miles, and to receive messages from the high-powered station above mentioned at a distance of 3000 miles at all times, the apparatus to be capable of transmitting and receiving messages at the maximum radius with entire secrecy and without the possibility of interruption due to atmospheric conditions or intentional or unintentional interference. These sets to include as an adjunct wireless telephone apparatus capable of establishing and maintaining satisfactory communication to a distance between ships of 100 miles. Such communication to be sustained without adjustment of instruments or interruption therefrom for periods of at least 5 minutes. This ship apparatus must be so constructed as to be installed in a room with 100 square feet deck space. The antenna must be so disposed as not to require a change in the height or distance between masts or to materially change the outward appearance of the vessels."—*Electrical World.*

MARINE TURBINES AND GAS ENGINES.
LIQUID FUEL.

STEAM-TURBINES IN THE NAVY.—Considerable interest attaches to the trials of British warships during the year, as the majority of the vessels are fitted with Parsons turbines; but before dealing with these it may be stated that the few vessels already in commission fitted with this system

TABLE I.—STEAM TRIALS OF HIS MAJESTY'S ARMORED AND PROTECTED SHIPS IN 1908.

Name of Ship.	Type of Ship.	Builders of Ship.	Makers of Machinery.	Displacement.	Type of Boiler.	First 30 Hours' Trial.		Second 30 Hours' Trial.		8 Hours' Full Power.	
						I.H.P.	Coal per I.H.P. per Hour.	I.H.P.	Coal per I.H.P. per Hour.	I.H.P.	Coal per I.H.P. per Hour.
Lord Nelson.	Battleship.	Messrs Palmer.	Messrs. Palmer; Reciprocating engines.	16,500	Babcock & Wilcox.	3630	2.2	12,200	1.9	17,400	2
Bellerophon..	Do.	Portsmouth Yard.	The Fairfield Engineering Co.; Turbines.	18,600	Do.	4910	2.5	16,700	1.7	24,000	1.5
Defence	First-class Cruiser.	Pembroke Yard.	Messrs. Scott; Reciprocating engines.	14,600	Yarrow.	5780	1.9	19,500	1.8	27,500	1.8
Indomitable..	Do.	The Fairfield Engineering Company.	The Fairfield Engineering Co.; Turbines.	17,250	Babcock & Wilcox.	8480	2.6	29,300	1.6	43,700	1.2
Inflexible....	Do.	Messrs. J. Brown & Co., Limited.	Messrs. J. Brown & Co., Limited; Turbines.	17,250	Yarrow.	9130	2.3	31,400	1.8	43,300	1.7
Invincible....	Do.	Messrs. Armstrong, Whitworth & Co.	Messrs. Humphrys, Tennant, Ltd.; Turbines.	17,250	Do.	9300	2.3	31,500	1.6	44,800	1.5

TABLE II.—TRIALS OF A TURBINE TORPEDO-BOAT DESTROYER IN 1908.

Name of Vessel.	Type of Vessel.	Builders of Vessel and Makers of Machinery.	Speed on Six Hours' Run.
Amazon...	Torpedo-boat destroyer.	Messrs. Thornycroft & Co.	33.2 knots.

TABLE III.—TRIALS OF FIRST-CLASS TURBINE-DRIVEN TORPEDO-BOATS IN 1908.

Name of Vessel.	Type of Vessel.	Builders of Vessel and Makers Machinery.	Speed on Six Hours' Run.
			Knots.
No. 13	Torpedo-boat.	Messrs. J. S. White & Co.	26.4
No. 14	Do.	Do.	26.6
No. 15	Do.	Do.	26.5
No. 17	Do.	Messrs. Denny, of Dumbarton.	26.2
No. 18	Do.	Do.	26.2
No. 19	Do.	Messrs. Thornycroft.	26.2
No. 20	Do.	Do.	26.5
No. 21	Do.	Messrs. Hawthorn, Leslie & Co.	26.2
No. 25	Do.	Messrs. J. S. White & Co.	26.2
No. 29	Do.	Messrs. Denny, of Dumbarton.	26.2
No. 30	Do.	Do.	26
No. 31	Do.	Messrs. Thornycroft.	26.4
No. 16	Do.	Messrs. J. S. White & Co.	26.6

continue to give most satisfactory results. The *Dreadnought* has finished two years' commission, during which she has done an exceptionally large amount of steaming. In fact, under the new *régime* the ships are at sea for a much longer period of time than has ever before been the case. This is all for the good of the service. Notwithstanding this greater amount of steaming done, and the frequency of stopping and getting under way at a changed rate of steaming, the cases of temporary disablement have been remarkably few, and show that the engineering branch of the navy is in a high state of efficiency.

In Table I the results are given of official steam trials of the new ships of the armored class finished for the navy during the past year. The battle-ship *Lord Nelson* and the cruiser *Defence* are fitted with reciprocating machinery, and both installations have been fully illustrated in *Engineering*. The *Lord Nelson's* propelling machinery was fully described on pages 293, 398 and 421 of Vol. LXXXVI, and that of the *Defence* on page 835 of the same volume. The *Bellerophon* and the three cruisers of the *Invincible* class are, however, fitted with turbine machinery. Most interest attaches to the coal consumption. It will be noted that at full power the average rate for the four ships was rather under 1.5 pounds of coal per horse-power hour. The *Indomitable* returned the remarkably low rate of 1.2 pounds, which, of course, includes the fuel necessary for running all the auxiliary plant. The two reciprocating-engine ships averaged 1.9 pounds. Objection may be taken to such a comparison because of possible variants. The mean result for the three cruisers of the *Invincible* class is under 1.5 pounds, whereas in the case of the three cruisers of the immediately preceding class—the *Minotaur* trio—the average consumption at full power was 1.8 pounds, and in the six cruisers of the *Duke of Edinburgh* and *Warrior* classes the mean result was 2.1 pounds. The explanation is, of course, to be found in the fact that while in the *Duke of Edinburgh* the water consumption per unit of power developed by the main engines averaged 19 pounds, the consumption for the *Invincibles* was about 13 pounds. At lower power, however, the results are not quite so favorable. At what is regarded as the continuous cruising speed, when the *Invincibles* developed from 29,000 to 31,000 horse-power, the mean consumption was rather under 1.7 pounds. In the case of the *Minotaur* trio the mean result was slightly higher—1.76 pounds of coal per indicated horse-power—whereas in the six vessels of the *Duke of Edinburgh* class the mean was 1.95 pounds. At about one-fifth power the mean result for the three *Invincible* cruisers was 2.4 pounds, whereas in the case of the *Minotaur* trio the mean was 1.87 pounds, and in the six vessels of the *Duke of Edinburgh* class it was 2.05 pounds, so that here, as in all cases, it is found that at low power the turbine is not so economical as the reciprocating engine. The *Minotaur* trio attained the designed speed of 23 knots, whilst the cruisers of the *Invincible* class, designed for 25 knots, proved themselves capable of 26 knots. The speed of the ships varied considerably, as a consequence of the adoption of different types of propellers, and no doubt opportunity will be taken at an early date of utilizing the experience gained with all three ships, in order to adopt the screw the proportions of which are found to be the most satisfactory.

In Table II are given the trial results of the only torpedo-boat destroyer put through her paces during the year. In this case the legend speed was 33 knots, and on the six hours' run the actual rate was 33.2 knots. Four vessels of this class were tried in the preceding year, when the speeds varied between 35.67 and 34.5 knots, so that we have now in the service five vessels capable of maintaining 33 knots in favorable weather. The view, however, is entertained that it is better to make provision for heavy weather, and the new vessels to be built are to be made more seaworthy even at the expense of speed. Thirteen torpedo-boats have passed through their trial. These were originally regarded as coastal destroyers, but they have been more fitly classified later as torpedo-boats. Their displacement

tonnage ranges from 240 to 270 tons, and their length from 172 feet to 185 feet. With turbine machinery of 4000 indicated horse-power, the contractors were required to guarantee a speed of 26 knots; and it will be seen that in the thirteen instances this has been achieved on the six hours' run. As with their destroyers, Messrs. White, of Cowes, have been especially successful with torpedo-boats, their speed averaging 26½ knots. Messrs. Thornycroft have also succeeded in averaging over 26¼ knots, and in most other instances the rate was 26.2 knots. The conditions as to load and oil consumption were severe, and the Admiralty and the contractors alike are to be congratulated on the results.—*Engineering.*

TURBINE PROPELLERS.—The extraordinary change that has taken place in recent years in the proportions of screw propellers for turbine steamers compared with those adopted for reciprocating engine vessels is about to be accentuated by an experiment that is being tried on the Cunard Liner *Mauretania*. When this vessel ran her trials she was fitted with four three-bladed propellers 17 feet in diameter by about 16 feet pitch, and she attained about 26 knots with 190 revolutions and 78,000 shaft horse-power. The screws were modified long ago in the *Lusitania:* the diameter was reduced in order to obtain a greater clearance between the tips of the blades and the hull of the ship; but it is only just recently during her annual overhaul that a change has been made in those of the *Mauretania*. Propellers of the original dimensions are being retained on the two inner shafts, but four-bladed screws have been fitted on the two outer shafts. The proportions of pitch, surface, and diameter are similar to those of the original screws, but the shape of the blades has been altered considerably. Hitherto almost every turbine propeller has been oval or circular; and whether wide at the tip or purely elliptical, it has had the area distributed symmetrically on each side of the center line of the blade. Nearly all have been three-bladed.

The change is being made more from the point of view of modifying the vibration than from propulsive considerations, but it is the latter which calls for attention. Additional facts bearing on the efficiency of turbine propellers are being eagerly sought for, and in this case the change should afford data of more than ordinary interest. The new screws are cast solid instead of having blades secured to the boss; they possess to a much greater degree than we have yet seen in turbine steamers the characteristics of a tramp steamer propeller, especially from the point of view of shape of blade. How such a type with the narrow blades common to the latter style of practice will operate at turbine revolutions remains to be seen. Not a few marine engineers believe the *Mauretania* and *Lusitania* to be fitted with larger propellers than are really necessary. Both slip ratio and thrust per square foot of blade area were very low on trial even at the highest speed. Naturally, in a seaway, when the same power is being developed and the ship is retarded by the weather, both these items are considerably increased, but even then they are low compared with other turbine steamers, and it is considered highly probable that slightly smaller propellers, which would possess the additional advantage of running faster, would be more efficient in smooth water, and owing to their increased clearance from the hull, would not cause as much vibration as the original screws did.

At the last meeting of the Naval Architects, Mr. R. E. Froude read a paper of particular value on the efficiency of propellers as deduced from model experiments. The main fact to be gleaned from his admirably compiled curves is that within very wide limits of pitch ratio the efficiency of propellers with a standard shape of blade falls off proportionately much less rapidly with reduction of pitch ratio, than for a standard pitch ratio it decreases with increase of area ratio, more particularly when the ratio of area to disc exceeds about 70 per cent. In other words, the practical designer is apt to be more correct if he adopts a large diameter in association with a medium area ratio and fine pitch ratio than if his area ratio

is very big and his pitch ratio coarse. It is in absolute size and not in proportion that the Cunarder's propellers are thought to be too large, and with those figures of Mr. Froude's in our mind we cannot help hoping that in the interests of the profession any further changes will be systematic, so that we may get additional corroboration of model experiments from actual practice. So far, the trials of numerous other vessels have proved the accuracy of the above theory. The propellers used on the coastal destroyers, which may be said practically to represent the present minimum size of turbine propeller, differ considerably in proportions on the various ships. The turbines are the same in nearly all cases, but estimates of the relative efficiencies of the propellers are impossible owing to the lack of space available for fitting torsion meters. In one or two cases, however, similar ships were tried with different propellers; but even then, whatever the speed results may have been, the efficiency was still unobtainable. In some of these vessels very exaggerated area ratios have been adopted; in others it has been quite moderate, but neither can, we fancy, be as favorable from the propulsive point of view as they might be. The value of the data given by Mr. Froude is, so far, hardly appreciated at its full value; but it gives cause for reflection as to the scope apparently available for improvement in turbine propeller efficiency. The propellers of the *Kaiser Wilhelm II* have an efficiency of B. H. P. ÷ E. H. P. of about 64 per cent, those of the *Lusitania* and *Dreadnought* about 48 per cent. If only half the difference were attained—and we cannot help thinking that it will be attained, though not, perhaps, this time in the case of the *Mauretania*—the average daily coal bill would be reduced by about 120 tons—say, from 900 to 780 in twenty-four hours, taking only the propelling machinery into account. The vessel is running at least 180 days out of the year—rather more, perhaps—say, $120 \times 180 = 21{,}600$ tons per annum, and for two ships $= 43{,}200$ tons of coal a year at, say, 14s. per ton average price, which represents a saving of over £30,000 a year to attain the same speed. On the other hand the same shaft horse-power and consumption would, if used with a 56 per cent propeller efficiency instead of 48 per cent, give 25.75 knots instead of 25. We take our basic figures from Mr. Bell's paper on the *Lusitania*. The efficiency suggested is good for turbine work, though not exceptional, but it is not one that would appeal to the owners of the *Kaiser Wilhelm* or *Deutschland*. An efficiency of even only 53 per cent would reduce the coal bill nearly 10 per cent. With the saving possible it would appear to us a financially sound step to experiment with propellers of modified form with a view to increasing the efficiency. For propellers of 17 feet diameter running at 180 to 190 revolutions, 48 per cent efficiency strikes us as being ridiculously small. The efficiency in the case of the propellers of the later *County* class, which were only about 12 inches less in diameter and which revolved at nearly 150 revolutions, was well over 60 per cent, and it is difficult, indeed, to believe that the lower figure cannot be improved.—*The Engineer.*

The recent visit of the "Mauretania" to the dockyard for cleaning and overhauling gave her builders the opportunity to stiffen her after-hull, and to ship a pair of four-bladed propellers in place of those which were lost on previous voyages. The improvement when the ship left drydock was at once noticeable in the absence of vibration and the greatly improved speed of the ship. On her last voyage to the eastward, concluded in very heavy weather, she broke the record by steaming over the long course in 4 days, 20 hours and 27 minutes, at an hourly average of 25.2 knots, both of which performances are records. A third record was placed to her credit on the second day out from New York, when she logged 605 knots in the 23 hours from noon to noon, which is equivalent to an hourly average of 26.34 knots. On the return trip to the westward, during the first day out from Queenstown the ship covered 671 nautical miles, which is equivalent to an hourly average of 26.84 knots for the 25 hours from noon to noon. This all-day

run of the turbine ship, made as it was in the winter season, renders her a very likely candidate for the honor of becoming during the summer months the first ship to cross the Atlantic at an average speed of 26 knots. On the second day out she covered 671 knots; on the third, 647 knots; and on the fourth, 668 knots. The total time for the whole trip was 4 days, 17 hours and 6 minutes, and the average hourly speed for the whole trip works out as 25.55 knots.—*Scientific American.*

LIQUID FUEL STORAGE.—In "The Progress of Warship Engineering," reprinted from the 1908 edition of "Fighting Ships," Mr. C. de Grave Sells, gives some interesting details of the steps which are being taken by the Admiralty in connection with the utilization and storage of liquid fuel. The British Admiralty, he says, seems thoroughly alive to the importance of providing adequate storage, and has converted several obsolete vessels into tanks for the storage of the oil at the principal dockyards. A large depot is to be constructed at Turnchapel, near Plymouth, and the work has already been commenced. It is of such magnitude that it will require two years for its completion, but a part of it will be ready for use before that time. The works actually contemplated will give sufficient capacity for the storage of over 30,000 tons of fuel with ample provision for such further expansion as may be found necessary. The tanks are to have a capacity of 5000 tons each; they are to be sunk to a great depth so as to screen them adequately, and they will also be protected by raised mounts. The supply and delivery pipes are to be well defended by being laid in deep trenches between the jetties and the tanks. A similar work is to be carried out at Portsmouth, the storage tanks being of like size and capacity to the Plymouth ones. A jetty is also to be constructed alongside which the largest warships of the fleet will be able to moor, and some of the necessary widening and dredging operations in the harbor have already been commenced. On the Mersey another large store is to be built about half a mile above Port Victoria, where four steel tanks each capable of holding 5000 tons of oil fuel are to be constructed, and like the others, protected by earthworks. Berthing accomodation is to be provided for a length of 400 feet, and battle-ships and cruisers will be able to go alongside mooring stages in the river at any state of the tide to take in oil fuel, which will be pumped from the tanks ashore, and supplied through pipes carried to the mooring stages.

Until this work is completed the storage will be carried on in large barges which have been specially built for this service. They are 130 feet 6 inches in length, have a beam of 32 feet, and a displacement of 750 tons. A pump is provided on board for supplying the oil to other vessels, and this is driven by an electric motor which is to be supplied with current derived from the ship which is receiving the oil. At South Shields it is proposed to build store-tanks, whilst at Granton, Invergordon, Harwich and Grimsby, store barges similar to those above described are to be stationed, each of the capacity of 500 tons, and similarly fitted with pumps, electrically driven.—*Page's Weekly.*

Owing to the decision of the Admiralty to use coal instead of oil for raising steam in the latest torpedo craft, various schemes for the formation of oil fuel depots are likely to be affected. The depot at Turnchapel, Plymouth, provided for six large steel tanks, but, in consequence of the change referred to, the demands for oil fuel for torpedo flotillas are likely to be considerably reduced, and it has, therefore, been decided to erect only four tanks, thus reducing the projected storage by one-third. The space which becomes available will be retained to meet possible developments in connection both with oil and petrol propulsion. The reduction of the storage capacity at this depot will, it is expected, lead to renewed activity on the site of the projected coal depot in the immediate vicinity. The formation of this depot was commenced some years ago, and consider-

able work was done, including the erection of sets of lofty wooden gantries, to provide for the rapid transfer of coal to the adjoining jetty. With the introduction of oil fuel, however, the work was suspended.—*The Engineer.*

MISCELLANEOUS.

THE AEROPLANE IN WAR.—British watchfulness, ever alert against anything destructive to the protection afforded by England's fleet-encircled insularity, has risen in warning against the flying machine.

Prof. Newcomb's apparently well-grounded demonstration of the very small efficacy of the aeroplane as a war engine (published in the *Nineteenth Century* for September and reviewed at length in our November issue) has brought to minds of this type not reassurance, but increased agitation, and Major B. Baden-Powell replies to Prof. Newcomb in the November *Nineteenth Century.*

The introductory argument of the advantages and asserted disadvantages of the aeroplane offered in rebuttal of Prof. Newcomb's case may be passed with little comment. It is fair to assume that when Major Powell speaks of the aeroplane as traveling "infinitely faster for the same propulsive power," he intends to use the language of enthusiasm rather than that of engineering; his assertion that the aeroplane is "practically invulnerable to bullets" must perhaps be left to future demonstration, though we would be disposed to back the machine gun very heavily as the winner on that issue; but when he offsets the objection that the aeroplane "cannot stop to have its machinery repaired or adjusted" by the plea that "the engines could be stopped for a few seconds while the machine soars downwards," he is taking the discussion out of the bounds of practical engineering. The prospect of effecting mechanical repairs to the power or transmission of an aeroplane during "a few seconds" of downward soaring is not attractive from a mechanical point of view.

It is on the military side, however, that Major Powell's enthusiasm for the aeroplane leads him to the most curious proposition of all. Turning to the question of the invasion of England he asks "what valid reason is there why, within a few years' time, a foreign nation should not be able to dispatch a fleet of a thousand aerial machines, each carrying two or three armed men, and able to come across to our shores and land not necessarily on the coast, but at any desired inland place?"

Let us suppose that there is no valid reason why the 2000 or 3000 armed men should not be landed at any place, coast or inland, and let us ask Major Powell in return what would they do—3000 men in the middle of England with only such ammunition as they could carry, without field guns, without cavalry, without commissariat, wagon trains, or base of supplies—with nothing but their rifles and a few cartridges?—*The Engineering Magazine.*

HEIGHT OF FUNNELS.—It is reported that the funnels of the *Minotaur* class, which were made shorter than in previous practice, are to be raised 15 feet; experience showing that with their present height the bridges are almost uninhabitable.

Admiral Sir Cyprian Bridge has been tackled by the ubiquitous interviewer on the subject of the growth of Socialism in the navy, which the writer of a series of instructive articles in the *Times* described as "a very serious matter." The admiral's views appeared in the *Manchester Evening Chronicle,* and from his tribute to the qualities of the British bluejacket we quote the following:

"I have the utmost confidence in the loyalty and good spirit of our seamen, and it is my firm conviction that whatever may be their political opinions, it will not affect them as a fighting force, though, as I say, there

may be a few extreme cases. Besides, what is meant by Socialism? Do the men know? Many of my friends in London declare they are Socialists, and yet do not know the meaning of the word."

The admiral then referred to the curious beliefs which at times prevail in the navy, and told the following anecdote:

"I remember that over thirty years ago a small sect arose known as the Jarmanites, and one of their ideas was that a man ought not to fight; in fact, a petty officer avowed that he would not fight. He was tried by court-martial and dismissed from his ship as useless, though he had been a capable man. Cases of that sort must happen from time to time, but the overwhelming body of the men are thoroughly loyal, and in every way—physically, mentally, and morally—of a very high type."

We are reminded by this anecdote of another which appears in Commander Robinson's forth-coming work, "The British Tar in Fact and Fiction." It is therein related how on board the *Bristol* in 1657 there was a little band of Quakers who were noted as being among the handiest men in the ship. It came about that after an engagement with a Spanish vessel serious doubt fell upon the Quakers as to whether they did right in fighting, and at last one of them, taking his courage in his hands went to the captain, saying he could fight no longer. "Then," exclaimed the captain decisively, "he that denies to fight in time of engagement I will put my sword in his guts!" "Then," said the Friend, "thou wilt be a manslayer and guilty of shedding blood," upon which we are told that the captain beat the offending man sorely, and fixed up a printed order on board the vessel, saying: "If any man flinch from his quarters in time of engagement, any may kill him." Sir Cyprian Bridge concludes his remarks:

"Sailors, from the admiral to the A. B., are notorious grumblers, but that does not show dissatisfaction. It is a habit; you may take it that it is safe to place perfect confidence in the great bulk, the overwhelming proportion, of the men of the British Navy."—*Army and Navy Gazette.*

The first Schlick gyroscopic apparatus made in England for preventing ships from rolling at sea has been constructed at the Neptume works of Swan, Hunter & Wigham Richardson, Ltd., Newcastle, and has been fitted in the steamship *Lochiel*. The apparatus can be thrown in or out of action at will. When out of action the *Lochiel* rolled to angles of 16 degrees on each side—that is, the total angle of roll was no less than 32 degrees—and when the apparatus was put into action the rolling was decreased to a total angle of roll of from 2 to 4 degrees. The gyroscope on the *Lochiel* is driven electrically and needs little attention. It requires but little space in the steamer, as the design has been simplified and is now very compact.—*Iron Age.*

Every British passenger ship will probably, in a short time, be compelled to carry an aerial torpedo of a remarkable type, which will carry a life-line to shore in case of wreck, and so prevent such a disaster as befell the *Berlin*. The advisory committee appointed by the Board of Trade concluded its sittings last week, and we understand that it has practically decided on the torpedo which was invented by Colonel Unge, the man who sold the aerial war torpedo to the German Army. It threw a line with the utmost accuracy, 360 yards in the test, and it can carry a rope of sufficient strength to support the "breeches buoy" without another rope being hauled to shore. Balloons, kites, rockets and miniature cannon were also tried, but none proved so satisfactory as the aerial torpedo.—*United Service Gazette.*

Rear-Admiral Gamble, who has been "lent" to Turkey for a term of three years, to superintend the reconstruction of the Imperial Navy, had his share of active service in the Egyptian Campaign of 1882, as well as on the Gambia and the Brass River, a dozen years later. The latter business

occurred when Colonel Sir Claude Macdonald was looking after the Niger Coast Protectorate, and was brought to an exceptionally satisfactory conclusion under his personal direction. The exceptional circumstances were that the Brass men were fined £500—and that the money was obtained from them.

Admirals of the British Navy are not often "lent" for such an office as Admiral Gamble will undertake. The tenth Earl of Dundonald, when Lord Cochrane, more than once "lent" himself, and for more serious objects than reorganization. He commanded the Chilian Navy in the war of 1817, against Spain, and that of Brazil on a later occasion, and was badly treated over both commands. Also he was commander-in-chief of yet another navy—that of Greece, during the War of Independence—with not much more satisfactory results in the way of personal treatment.—*United Service Gazette.*

THE GYROSCOPE AS A COMPASS.—The second paper delivered at the recent meeting of the German Institution of Naval Architects, was entitled "The Gyroscope as Direction-giver on the Earth, with Special Reference to its Applicability to Ships," and it was written by Dr. Anschütz-Kaempe, of Kiel. The author began with a reference to the deviations of the compass in iron and steel vessels, and especially in war vessels when it has to be placed under the armored deck, and pointed to the desirability of a substitute being found for it which should be free from the influence of masses of iron and steel. He recalled the fact that Foucault had suggested the use of the gyroscope for this purpose some sixty years ago, but said that the invention of the three-phase electric current with short-circuit "anchor" had first made it possible to put the idea into practice.

It was set forth that a gyroscope in motion had the tendency to preserve its position in space while the earth was rolling round under it, and that its apparent alterations of position with reference to the latter were different, according as it was hung at the equator, at the pole, or somewhere between them. When deflected by the earth's rotation, it had the tendency to stagger and describe with its axis cones of larger or smaller diameter of base in longer or shorter periods. These motions were brought into connection with a pointer, which indicated the direction of the vessel as on the old system. For the use of the gyroscope as substitute for the compass it was found necessary to damp the motions of the instrument by the application of a current of air, which reduced the period to 70 minutes and the deviation to 3 degrees, the latter figure representing the maximum registered during a month's careful observation on a war vessel at sea. It was, in fact, found to be possible to bring the deviation down to 1 degree. Stress was laid upon the fact that the troublesome compensation required by the ordinary compass was avoided entirely by the new arrangement, and that the latter was effective in places where the impossibility of making such compensation forbade the use of a compass altogether. One of these places was the conning-tower of an armor-clad. The use of the gyroscope was also advocated for vessels that carry iron ore.

In general size and appearance the new binnacle, as shown by pictures on the screen, did not greatly differ from the old form, but an important difference between the two systems consists in the constant supply of electricity now required. The lecturer claimed to have shown the gyroscope to be a really serviceable instrument for navigation purposes.

The discussion was opened by Professor Schilling, Director of the Seafarers' School in Bremen, who said that the relation in which he stood towards the Norddeutscher Lloyd led him to pay attention to all instruments connected with navigation, and that he had watched the development of this compass for a number of years. He had taken part in a trip two-and-a-half years ago, when the instrument, after nearly three hours' working, broke down on account of a short-circuit, and again, this spring,

he had seen it after four weeks of uninterrupted running, when it still preserved its initial adjustment. The problem of the employment of the gyroscope as a mariner's compass might in so far, then, be considered as solved, and, although the apparatus was for the present very expensive, it might yet, for certain purposes, be looked upon as a good substitute for a magnetic compass. The question then arose whether it was of importance for the merchant service. Its high value for the navy was beyond doubt, for the immense masses of iron around it, parts of which were frequently moved about, exercised a very unpleasant influence on the magnet. The question was whether it was possible to use the ordinary compass on a merchant ship for all purposes, and he was in a position to declare that it is was possible. He then went on to explain how by using non-magnetic steel in various parts of the ship in the neighborhood of the compass disturbances had been overcome. In the steamers *Goeben* and *Lützow* the effect of this had been so striking that the compasses of these vessels could now be pronounced perfect; only one magnet had had to be resorted to, notwithstanding that the vessels were employed in southern latitudes. A still better result was hoped for in the new steamer *Berlin*, since the front bulkhead of the bridge-house for a width of 10 ft. had been made of nickel-steel, and a more extensive use of the same material had been made in the bridge side plating, with the result that the horizontal component of the influence of the soft iron had been neutralized. He wished to point out that not even a small strip of iron should be fitted above a bridge. He had made these statements in order to show that the adoption of the gyroscope as a permanent instrument of navigation was not a necessity in the merchant service, since arrangements could there be made that rendered the ordinary compass a serviceable instrument. In general, then, he discarded the gyroscope for the merchant service, but there also there was one application for which it was suitable. During the construction of a vessel the latter had no completely uniform magnetic system. This varied in the course of the work, and did not become uniform till a year after its completion. This state of things could be altered in the shipyard by the expedient of mooring the vessel, during the time of her fitting out, in a direction exactly at right angles to that of her building slip, but few yards were in a position to do this. During the first months, then, no captain would be able to depend upon his compass, and the large shipping companies should place gyroscope apparatus on board their newly-built vessels as a check on the magnetic compass in each case. This would be necessary only for the first six months; after that it would cease to be required. Unfortunately, the still very considerable expense would stand in the way of this.

Herr Martienssen believed that the objections made to the instrument two years ago still held good. When the compass card oscillated very slowly it would not be possible to distinguish such oscillation from those of the vessel herself. Assuming the compass card to begin to oscillate, the oscillations would continue for several hours. True, the fitting of the damper rendered the occurrence of such oscillations less likely; he believed, however, that disturbance enough would remain. He would like to ask Dr. Anschütz whether he could guarantee that the apparatus would be free from disturbance for a given length of time—say, for twenty-four hours. His belief was that the experiments had only proved that this would be the case under exceptionally favorable circumstances. If the gyroscope was to be used in the merchant service only as a check apparatus, this could be done while the ship was lying still. He might mention that exhaustive experiments with such instruments had been made in the eighties in the English, French, and Dutch navies, but they had been subsequently abandoned.

Professor Apt said the gyroscope was affected by the motions of the vessel and not only by those of the earth. A considerable defect appeared to him to lie in the damping apparatus, since a turning moment was set

up which sought to bring back the axis of rotation to the N. S. direction. Now, when a pendulum was in motion for days together, it also would assume an oscillation of its own, so that after a certain time it would cease to work exactly. With assistance from the nautical department of the navy office he had for some time been at work on the construction of a gyroscope apparatus of this kind, and could now state that the influences on the damping appliance could be almost overcome.

Korvettenkapitan von Schönberg said: "We had heard that it was not the intention of the large steamship companies to adopt the gyroscope. It was of interest, however, to examine the points which were of value from a military point of view. The requirements made by the magnetic compass on the shipbuilder were considerable; for it was, in the first place, very sensitive to contiguous masses of soft iron. These harmful influences could be combated by the expedient of interrupting the continuity of such masses. It was, in the second place, very sensitive to variations of temperature in the surrounding masses, so that it must not be placed near the boilers or engines. This latter could be avoided in merchant vessels without difficulty, but not so easily in war vessels. It was, further, sensitive to cables, electric leads, dynamos, etc., which influences could not be avoided in war vessels. As an example of this, he would mention that a deviation of 180 degrees was, in one instance, caused by a dynamo at 10 feet distance. The artillerist also was a trial to it, and the belief was prevalent that the magnetic compass could no longer fulfil the requirements. The magnetic compass very often broke down. He based this assertion on the official reports of the Dutch, English, and American navies. Thus, navigating compasses had had to be provisionally fitted on the deck aft behind the big guns. After the long voyage of the American fleet all the compasses in the steering room had become useless. Further, it was simply impossible to fit a compass in a conning-tower. The proof was thus given that the gyroscopic compass was, from the military point of view, a very welcome substitute for the magnetic compass."—*The Engineer.*

MARINE ENGINEERING, PAST, PRESENT, FUTURE.—Mr. James Denny, as president of the Institute of Marine Engineers, London, in his address took for his subject some recollections and lessons and their application, drawn from an experience of fully forty-three years of marine engineering. He said, the changes that have occurred during this period, the advances that have been made in marine engineering, will undoubtedly compare with the changes and advances made by any other industry in the country. Perhaps the progress during the period being dealt with may be illustrated if we take two vessels, both for the same owners, the British India Steam Navigation Co.; one of these the *India*, built in the early sixties, and the other, the *Rewa*, built two years ago. The *India* was 230 feet long by 30 feet beam, about 1000 tons, and the *Rewa* 455 feet long by 56 feet beam, and about 7000 tons. The *India* was fitted with one simple two-cylinder engine, 46-inch cylinders by 3-foot stroke, horse-power about 800; the water consumed per I. H. P. must have been approximately 30 pounds, but no accurate observations were then taken. The *Rewa* is fitted with three turbines with a shaft horse-power of about 10,000, and the water per shaft horse-power is 15 pounds for all purposes at the maximum speed. The *India* had two flat-sided boilers for 25 pounds pressure, with natural draft; the *Rewa* had two double-ended and four single-ended boilers of the cylindrical type, 155 pounds pressure, with forced draft. The speed of the *India* on trial was about 10 knots, and of the *Rewa* touching 19 knots. The *India* was the typical vessel of her fleet in her day; you will note that since then the tonnage—taking these two vessels as a comparison—has been increased seven-fold, the speed practically two-fold, and the power fully ten-fold. These are the broad bare facts and they show a sufficient advance, but in detail the differences are even greater. In the *India* the engine-room auxiliaries consisted of one steam donkey pump and one hand

pump, while the number of pipes in the machinery space was in all seventy; in the *Rewa* there are thirty-five auxiliary pumps and engines of various kinds, and 960 lengths of piping. The *Rewa* was fitted with hydraulic gear, electric light, refrigerating machinery, all of which were unknown forty years ago.

In the period under consideration, we have come then from the simple engine with jet condenser and 25 pounds pressure to the same engine with the surface condenser, then to compound engines with 60 pounds pressure, then to triple expansion engines with 160 pounds pressure, then to quadruple expansion engines, with from 200 to 220 pounds pressure, and now to turbines, with a possible development of triple or quadruple engines in combination with turbines. The steam turbine, especially for marine purposes, is still in its infancy, although a very sturdy infant it has grown to. Practically all marine turbines, so far, have been of the Parsons' type, but there are others, notably the Curtis, an American invention, for which excellent results are claimed. Mr. Parsons will be entitled to and receive all the honor due to the pioneer who has fought the fight and borne the stress that pioneer work inevitably necessitates. All others must simply be followers in his footsteps and reapers of profit by the good work he has accomplished.

It has frequently been suggested that if some inspired engineer would evolve a system of gearing that would be lasting and reliable, not too noisy, and would not absorb in friction more than say 10 per cent of power, turbine engines would be capable of application to any speed of vessel and to any size of propeller; you could then have a high-speed turbine and a low-speed propeller, which is the ideal condition for marine propulsion. This condition it is considered may be met in another way. The system devised by Mr. Durtnall consists of a fast-running turbine driving a small dynamo, the latter again transmitting its electrical power to and driving a large slow-running motor or motors coupled directly to the propeller shaft or shafts. This arrangement does not eliminate the loss caused by the friction of the thrust of the propeller, as is the case in the turbine, and as also, by the way, would not be the case in any system of gear-driven propellers; otherwise, one cannot but fear that the cost of this electrical system of propulsion will tell against it. A concrete case was recently put before a firm of electrical engineers who were strong advocates of such a system, but not Mr. Durtnall's; it was proposed to fit it in a ship, duplicate of one already at work with triple engines; the problem was the worst possible from the point of view of the advocates of the new system, but it was very carefully gone into and finally abandoned on account of the very considerable extra cost, and the doubt that existed if this would be met by the promised saving in coal consumption, even if the latter were attained.

There is still Mr. Parsons' latest system to test in the adaptation, or rather partial adaptation, of turbines to low-speed vessels: he claims that a considerable economy will be effected by using a higher vacuum than in the case of ordinary machinery, and by interposing between the main exhaust of the ordinary engine and the condenser a turbine driving an auxiliary propeller; that thus he will utilize the final expansion of the steam, which is largely lost in the ordinary engine, due to the smallness of the passages between the low-pressure cylinder and the condenser. There may also, in this system, be some gain due to the consequent less unequal temperature in the low-pressure cylinder, but that need not be gone into here. This system will be practically tried in a short time in a vessel for the New Zealand Shipping Company, and also in one now launched for one of the Atlantic lines; the results will be awaited with much interest by all interested in shipping. It is quite clearly understood that the crux of the problem is the relative efficiency of three propellers as compared with two, and this can only be determined by such practical experiments as are going to be made. Land installations have shown that the turbine, as arranged above, will give the economy claimed. Even if the first of the three pro-

peller arrangements does not give the results expected, a modification of the stern in the vicinity of the propellers, and of the propellers themselves, may finally bring them about. In any case, the experiment will be a most interesting one, and the owners who have sanctioned it are entitled to every credit for their enterprise.

As has already been said, the turbine is still in its infancy, and this question of the propellers for turbine engines is one which perplexes all who have studied the matter. The best practical remedy seems to be to peg away at trials, obtain all possible data, and tabulate and analyze such data carefully for future use; by this means in time there will be obtained the power of arriving at the best possible results under any given conditions with at least some fair degree of accuracy. You all know that as the turbine increases in the revolutions which are practicable in marine work, its efficiency increases; to obtain high revolutions the propeller sizes must be cut down, but this again decreases their efficiency, and the difficulty has always been and still is to strike the crossing lines of propeller and turbine efficiencies, so as to obtain the best combined result in terms of water used or in what is equivalent—coal consumed into the speed of the vessel. Coal consumed per shaft horse-power is not a measure of efficiency in the case of turbine-driven vessels; the only basis is as already stated—coal consumption in relation to the speed of the vessel, as is indeed the case with ordinary engines. You know in a general way that turbines as at present constructed are not suitable for low-speed vessels, but the reason why this should be so may not be quite so clear to you. You will best understand the reason perhaps by an illustration, always bearing in mind that the peripheral clearance of the blades and dummies is the important factor in the economical working of turbines. Take two vessels, one with a speed of 22 knots and the other with a speed of 12 knots, each requiring 10,000 horse-power for this speed. Design the propellers in each case on the usual basis for turbine-driven vessels, and make the turbines to correspond. In the case of the 22-knot vessel you will have propellers about 5 feet diameter running at nearly 700 revolutions, and in the 12-knot vessel the corresponding figures will be 13 feet diameter and 110 revolutions. Turbines corresponding to these revolutions will have such clearances that in the case of the slow-running vessel the clearance will be about five times as great as in the quick-running vessel. This clearance and its consequent leakage is the cause of want of economy in turbines of vessels running at slow speeds. A high blade in proportion to the diameter of the rotor, which is not admissible in such vessels, seems to be essential to economical working of turbines. While dealing with clearances, your attention may be called to an ingenious and simple invention recently brought out by Mr. Parsons, which he calls "tipping the blades." By this system, which will reduce the blades to a minimum section at the very point, it is safe to run turbines with much diminished clearance, and so increase their economy.

The past has seen great changes in marine affairs. What does the future hold for us? Apparently at least there is to be no standing still. The combination engine and the turbine driving propellers by electrical transmission have been already referred to, but there are other systems that have been suggested and advocated with at least some degree of reason; these are internal combustion engines, gas engines using producer gas, and oil engines: the first and last are used successfully in vessels such as racing launches and craft of small size, but matters are hardly ripe for their introduction on a large scale; the gas engine has also been given a trial, but the results seem so far to be inconclusive. The extended use of the water-tube boiler in vessels where weight is a serious consideration is one of the problems that must be solved sooner or later. Small and tentative experiments in this direction are even now being made by two enterprising bodies of shipowners, the South-Eastern and Chatham Railway Company, and the Irrawaddy Flotilla Company; if these experiments are successful, considerable modifications will take place in Channel and light-draft vessel practice.—*Scientific American.*

PROGRESS IN SUBMARINE CRAFT. By Robert G. Skerrett.—Despite setbacks, accidents and the skepticism of naval men who believe only in the might of the battle-ship, submarine vessels have continued to grow in size and military importance. A few years ago they came to us directly from the inventor's hands and showed all of the hall-marks of engineering inexperience. Enough, however, stood to the credit of those pioneer efforts to prove that their designers' claims were not unfounded, and at once the trained technical man set his mind to smoothing out the rough places and to reducing experimental data to figures of scientific value. Since then submarine craft have progressed rapidly, and to-day the best of them bear the impress of thoroughly serviceable units in a scheme of seaboard defence. No small part of this is the consequence of the general march in the mechanic arts, but the major part of the progress is directly attributable to the scientific analysis of the causes leading to the accidents that have shocked us. When all is said, the under-water boat has established its reason for being by a relatively moderate loss of life; and it has been only the harrowing circumstances surrounding this sacrifice which have seemed to give added gravity to the price paid.

British and French Developments.—The stiff-necked character of the official pride which Great Britain has in her navy caused that nation to be slow in adopting the submarine. It was said by one of her leading ministerial authorities that the submarine was merely the weapon of the weaker nation—it could have no excuse for recognition on the part of England, but the error of that position was duly focused in the light of contrary activity on the part of her neighbor across the Channel. To-day the British Navy, next to France, has the greatest number of submarine vessels, while in measure of displacement the flotilla of Great Britain exceeds that of France. Such has been the radical change in British official opinion.

Both Great Britain and France have accomplished very creditable results with their boats, and each of them has proof of the surface cruising endurance of those vessels. The British boats of 400 tons submerged displacement having covered 600 knots upon their gasoline supply and the French boats, under like conditions, having recently exceeded that record by nearly 100 miles. These performances not only indicate more seaworthy forms of hulls for these vessels, but show directly how the explosive engine has grown in reliability and efficiency. The latest French boats are of substantially corresponding displacement with that of the big British submarines.

The Remarkable Achievement of Italy.—Significant as these records are of improvement over the vessels of less than a decade ago, the recent achievement of the Italian submarine flotilla puts these performances quite in the shade. The Italian flotilla consists principally of four boats of only 220 tons submerged displacement, which were launched successively in 1905, 1906 and 1907, and which have taken part, as they were completed, in the naval maneuvers of the past three summers to the satisfaction of the authorities.

It was not until this season, however, that all four of the boats were able to maneuver as a unit, and it is putting it mildly in saying that what they did during the month of August just gone was startling. Part of the scheme of the naval maneuvers included a raid by these boats along both the Adriatic and the Mediterranean coasts, and the *Glauco, Narvalo, Otaria* and *Squalo* were called upon to make unassisted the run of nearly 1300 nautical miles from Venice to Spezia! The little boats accomplished this without mishap and with remarkable celerity, and arrived upon the scene of the grand maneuvers with their crews in splendid condition and able to take their part in the concluding operations in connection with the combined fleets. In this latter stage the little vessels were again handled by their officers and crew with so much skill that the King summoned them aboard the flagship *Vittorio Emanuele* and personally congratulated both

the commanders and the enlisted men. One of the circumstances leading to this rather unusual honor was the especial performance of the *Glauco*, the first of the flotilla completed, which in broad daylight was able to actually hit the battle-ship *Saint Bon* twice, despite the vigilance of picket boats and the watch aboard the big ship, before rising to the surface and showing her nearness.

The position of excellence won by the Italian boats is of particular interest because Italy did not figure conspicuously until within the last four years in this branch of naval architecture. While England, France, Russia and the United States were spending large sums of money in buying or building various types of submarines, Italy was going along in a quiet way experimenting with her old submarine, *Delfino*, modified. The lessons thus learned at a modest outlay were carefully evaluated, and the *Glauco* and her remarkable classmates have been the outcome. Surely the records made by these little vessels stand out in brilliant contrast with the results recently secured from our own boats during their run to Philadelphia and return to New York, a distance each way of approximately 300 miles.

Statistics of Submarines Built or Building.—The following table shows the number of submarine vessels built, building, or authorized in the various maritime nations, distinguishing between the submarine and the submersible, the latter being a seaworthy evolution of the former:

	Before 1902.		Since 1902.		
Nation.	Submarines.	Submersibles.	Submarines.	Submersibles.	Total.
France	31	5	10	52	98
England	6	0	14	34	54
United States	8	0	11	1	*20
Italy	2	0	0	5	7
Russia	8	1	8	13	30
Japan	0	0	7	0	7
Germany	0	0	0	10	10
Sweden	0	0	1	1	2
Holland	0	0	1	0	1
Austria	0	0	0	4	4
Norway	0	0	0	1	1
Denmark	0	0	0	1	1
Totals	55	6	52	122	235

*Congress at its last session authorized the construction of eight more submarine torpedo-boats, and competitive bids for these vessels were opened at the Navy Department on November 2. It will probably be some little while before we know anything at all about these boats, as the details will naturally be kept secret.

The Submarine may Displace the Destroyer.—The development of submarine craft has provoked very serious discussion as to the advisability of abandoning the further building of high-speed surface torpedo-boats of the well-known destroyer type. These vessels in order to attain the high speeds now demanded and to be seaworthy have grown to such sizes that they make very considerable targets for the rapid-fire guns of a modern fleet, and at night are apt to betray their approach either by reason of their size or the disturbance they make in the water when running at high speeds. The primary duty is that of scouting and their torpedo armament is carried more as a secondary consideration, and in the hope that they may be serviceable in case of an opportunity of a more or less remote character. It is urged that the destroyer be abandoned and that scouts, pure and simple, be built in their stead, and that submarine craft be developed for the primary purpose of providing a satisfactory mobile base from which to discharge torpedoes. The modern submersible can be made ready to dive

in 6 minutes after she has been running on the surface in light trim, which is a very material gain in powers of quick disappearance over the 20 or 30 minutes called for only a short while ago for vessels of very moderate displacements. In addition to this the latest boats are able to run in cruising trim at a speed of 15 knots an hour, while they are accredited with submerged speeds of 9 knots an hour.

In broad daylight all that the submarine craft shows above the surface when making an attack is the slender tube and small head of her observing instrument, and this is now so installed that it can be thrust above the surface or withdrawn out of sight without altering the depth of submergence of the submarine boat. As the attack upon the Italian battle-ship showed, and as experiences during a number of the French maneuvers have substantiated, it is possible for these vessels to get within striking distance of their targets in broad daylight. Striking distance does not mean now getting within range and there blowing a whistle or giving some other signal of being near, but torpedoes are now fired having collapsible heads which permit without fear of damage of actual blows or hits being recorded. It was this very type of torpedo that showed how fallacious were the probable powers of the surface torpedo-boat in attack, because only actual hits were allowed to count and only those hits made against pre-determined ships.

The Automobile Torpedo.—The average layman does not realize how the automobile torpedo has been developed within the past few years, and how its range, its speed and the force of its destructive blow have been increased. The attack upon the United States steamship *Florida* gave a fair idea of its powers to damage under the most restricted circumstances, and a blow of that sort under the engine space would probably paralyze a ship's motive force, while the explosion of a torpedo under any one of the magazines would probably lead to the immediate destruction of the vessel. It was not very long ago that 800 yards was considered the probable maximum efficient range of the torpedo, and yet to-day, by reason of the use of a superheater, the motive air capacity of the torpedo is doubled and the range has widened to a distance of 4000 yards at a speed of 28 knots, while for the first 1000 yards the big 18-inch torpedo can be driven at a speed of 43 knots an hour! It is quite impossible to make use of this maximum range from any surface torpedo craft during daylight, and daylight is necessary in order to enable the torpedo to be properly aimed at a moving target.

As a surface torpedo-boat cannot do this work without inviting well nigh certain destruction, the submarine boat is apparently the only torpedo craft that can lie at a distance of 4000 yards in the daytime, submerged of course, and profit by the increased range which has been given the up-to-date torpedo. The periscope of a few years ago would have made this quite impossible, because its defective optical properties gave no idea of true distances after an object had passed 200 or 300 feet away. To-day thanks to the genius of the optician, this difficulty has been overcome, and the officer in command of a submerged submarine is able to judge with remarkable accuracy the approximate range of his target, while further improvement has given to this eye of the submarine all of the properties of a good night-class for making observations after dark.

The submarine vessel is thus surely coming into its own, and it is but another proof of what can be expected when a field of usefulness is established for any military instrument and the inventor and his more finished brother, the technicist and practical man, put their heads together to solve the problem and to meet a commercial demand.—*Iron Age.*

THE LIFE-SAVING STEAMER "SNOHOMISH."—The steamer *Snohomish* of the U. S. Revenue Service, the first vessel ever designed and built entirely for life-saving work, has sailed from Norfolk on a voyage nearly 20,000 miles long to the station she is to occupy at Neah Bay on the Alaskan coast.

The *Snohomish* carries all the standard life-saving apparatus, but the most important part of her equipment consists of an apparatus designed especially for life-saving, under conditions which render all other means futile. Although the operative features of this apparatus have been thoroughly proved under other conditions their application for life-saving is entirely novel.

The official trials took place at Arundel Bay, Md., during the week of November 17, 1908, and the officials of the Revenue Service have expressed their entire satisfaction with the life-saving apparatus. The revenue cutter *Itaska* acted the part of a wreck from which rescues were made.

The need of some device which would carry passengers from a wreck to a rescuing ship and maintain communication has been felt for many years. The Life Saving Service, not only of our government, but that of others, have been seeking for just such a device. The U. S. Revenue Cutter Service invited the Lidgerwood Manufacturing Company to submit a study for a small-sized marine cableway capable of carrying passengers between a wreck and a rescuing ship, not only in the open sea, but also along our coasts.

The Spencer Miller Marine Breeches Buoy is the result. The apparatus has been constructed and received its preliminary tests. The tests have established its practicability.

The *Snohomish* and her life-saving appliances are for service where there is no life-service station on the shore, or the wreck lies beyond the reach of the shot line and amid seas in which no small boat could live. In such instances, staunch vessels have often been able to approach wrecks but for lack of proper apparatus were unable to give help. In some instances, shot lines were sent aboard and cables made fast but before any one could be saved, the pitching and tossing of the vessels parted the lines and rendered the attempts futile.

Similar conditions have often made it impossible for vessels at sea to render help to others and seamen and passengers have perforce been left to the wild mercies of the storm.

Great losses of life in recent years on the northwestern coast of the United States brought vividly before government officials the necessity for some new form of life-saving apparatus which would meet these conditions. The entrance to Puget Sound through the Straits of Juan de Fuca is particularly dangerous. Through half the year at least fogs and haze prevail and at times erratic currents exist which are little understood even by men who navigate these waters constantly. Nearly 6,000,000 tons of shipping pass through these waters annually. In the past half century nearly 700 lives have been lost in this immediate vicinity.

The total loss of the passenger steamer *Valencia*, and the loss of 136 lives at the entrance to the Straits of Juan de Fuca on January 22, 1906, served as the immediate incentive to provide a new and improved means for saving life in these waters. It was conceded that the 136 lives could all have been saved if the wreck had occurred within the reach of a life-saving station, or if there had existed in those waters, a life-saving vessel fitted with the necessary apparatus. The wreck did not go to pieces for 36 hours after the vessel struck.

The U. S. Government, always foremost in humanitarian work, took action at once and Congress authorized the expenditure of $100,000 for a suitable vessel provided with apparatus for rescue, placing the execution of the project in the hands of the Revenue Cutter Service.

The *Snohomish* is a powerful ocean-going tug of 795 tons displacement. She has a full equipment of life boats, life rafts, searchlights, and other well-known life-saving appliances, and besides these will carry the Spencer Miller Marine Breeches Buoy. This apparatus is the well-known breeches buoy used in the life-saving stations on our coasts, combined with devices for operating and keeping the cable always under an even and safe tension no matter how the seas toss the vessel about. The efficiency of these

appliances had been previously proved in the Lidgerwood-Miller Marine Cableway for coaling war vessels in a seaway.

The two special features of this apparatus are an automatic reel which constantly gives and takes on the cable, while maintaining a tension nearly as even and constant as if the vessels were at rest, and a downhaul by means of which the passengers in the breeches buoy are safely landed on deck without regard to the boisterous character of the seas.

A rust-proof cable line of light steel 1500 feet in length is provided. This will permit of the operation of the life-saving apparatus up to more than a thousand feet between the vessels.

In operation a line will be shot over the wreck as is now the practice and the men aboard the wreck will haul the light manila whip line and block aboard and make it fast at one of the mast tops. As soon as this is done the crew of the life-saving vessel will work the whip line and pass the wire cable and breeches buoy to the wreck. Power is available to assist in this. The cable passes to the automatic reel through a block at the mast head of the life-saving vessel, thus keeping it as well above the seas as is practicable. When the breeches buoy is hauled back and a passenger is to be taken out, the downhaul is brought into action. This operates from amidship on the after deck, hauling the bight of the cable always to the one spot on the deck of the life-saving boat, no matter how much she may be yawing or tossing, and keeping the breeches buoy in one place in relation to the vessel's deck. This makes it possible for the crew to readily lift out helpless passengers and prevents entirely the danger which otherwise would exist of breaking their limbs or otherwise injuring them by violent contact with the vessel during a storm.

Besides its usefulness for life-saving, this apparatus is available for saving specie, mails, baggage, and other kinds of light and valuable cargo when time serves for such purposes.

ANNUAL REPORT OF THE SECRETARY AND TREASURER OF THE U. S. NAVAL INSTITUTE.

To the Officers and Members of the Institute:

Gentlemen:—I have the honor to submit the following report for the year ending December 31, 1908.

Itemized Cash Account.

Receipts During the Year 1908.

Items.	First Quarter.	Second Quarter.	Third Quarter.	Fourth Quarter	Totals.
Dues	$1,307 55	$ 653 10	$ 230 77	$ 237 00	$2,428 42
Subscriptions	481 15	384 26	291 96	279 85	1,437 22
Sale of extra publications	5,471 20	4,903 56	4,807 41	7,186 27	22,368 44
Sale of Proceedings	204 38	54 02	14 84	103 88	377 12
Advertisements	350 00	366 12	139 69	541 66	1,397 47
Interest on investments	303 50	283 75	204 47	426 49	1,318 21
Binding	17 30	13 05	0 00	2 08	32 43
Credits	2 30	54	1 10	58	4 52
Postage	12	10 12	4 40	3 20	17 84
Expressage	0 90	0 00	75	35	1 10
Premium on draft	0 00	0 00	18	04	22
Bonds	0 00	0 00	0 00	2,917 50	2,917 50
Rebates on Insurance, etc.	0 00	0 00	0 00	87 60	87 60
Totals	$8,137 50	$6,668 52	$5,795 57	$11,78650	$32,38809

EXPENDITURES DURING THE YEAR 1908.

Items.	First Quarter.	Second Quarter.	Third Quarter.	Fourth Quarter.	Totals.
Printing and binding Proceedings	$ 678 76	$1,162 38	$ 968 27	$ 913 65	$3,723 06
Printing and binding extra publications	2,072 35	2,284 74	1,644 40	7,319 28	13,320 77
Authors of text books	0 00	400 00	100 00	2,418 40	2,918 40
Salaries	750 00	750 00	750 00	750 00	3,000 00
Paid contributors	378 00	415 00	326 50	430 00	1,549 50
Postage, drayage, expressage and telegrams	132 02	136 83	173 97	142 45	585 27
Stationery	9 51	39 35	0 00	98 72	147 58
Furniture	3 00	0 00	0 00	16 65	19 65
Prize Essay award	215 75	10 00	0 00	0 00	225 75
Honorable Mention awards	180 00	0 00	0 00	0 00	180 00
Advertising	15 00	17 85	0 00	0 00	32 85
Purchase of books mainly for sale	0 00	59 13	65 75	14 50	139 38
Rebate to Midshipmen's Storekeeper	0 00	23 40	0 00	0 00	23 40
Purchase of back numbers of Proceedings	0 00	10 00	0 00	9 50	19 50
Baltimore bonding Co.	0 00	0 00	7 50	0 00	7 50
Purchase of bonds	0 00	0 00	0 00	2,917 50	2,917 50
Insurance	0 00	0 00	0 00	80 00	80 00
Royalty on War on the Sea	0 00	0 00	0 00	40 00	40 00
Discount on money order and drafts	04	0 00	07	63	74
Miscellaneous	5 24	18 95	0 00	8 00	32 19
Totals	$4,439 67	$5,327 63	$4,036 46	$15,15928	$28,96304

SUMMARY.

Balance unexpended January 1, 1908, including $30.00 to the credit of the reserve fund	$28,409.70
Total receipts for the year 1908	32,388.09
Total available cash for the year 1908	$60,797.79
Total expenditures for the year 1908	28,963.04
Balance unexpended January 1, 1909	$31,834.75
Bills receivable for back dues	1,579.58
" " " binding	18.10
" " " subscriptions	111.22
" " " extra publications	3,825.81
" " " advertisements	357.29

Value of back numbers of the Proceedings	$ 300.00
" " Institute property	200.00
" " extra publications	2,500.00
	$40,726.75
Liabilities	1,126.01
Total assets	$39,600.74

RESERVE FUND.

Baltimore & Ohio and Northern Pacific Bonds	$4,683.14

The balance, $31,847.22, unexpended January 1, 1909, is distributed as follows:

Deposited in Seamen's Bank for Savings	$3,000.00
" with R. I. Hospital Trust Co.	2,601.28
" " Society for Savings, Hartford, Conn.	2,639.30
Southern Railway bonds	2,266.25
Washington R. R. and Electric Co.'s bonds	1,715.00
Northern Pacific and Great Northern bonds	7,945.00
Potomac Electric Power Co.'s bonds	2,115.00
Northern Pacific bonds	6,581.20
Baltimore & Ohio R. R. bonds	529.36
Farmers' National Bank, Annapolis, Maryland	2,033.23
Checks in safe in Institute office	361.63
Money orders in safe, Institute office	11.40
Cash in safe, Institute office	36.10
	$31,834.75

Respectfully,
PHILIP R. ALGER, *Professor U. S. Navy,*
Secretary and Treasurer.

The books of the Institute have been examined from January 17, 1908 to January 20, 1909, and found to be correct, and the balance sheet verified.

W. H. G. BULLARD, Lieut.-Commander, U. S. Navy.
N. M. TERRY, Professor, A. M., Ph. D.
H. F. BRYAN, Lieut.-Commander, U. S. Navy.

LIST OF PRIZE ESSAYS.

1879.

Naval Education. Prize Essay, 1879. By Lieut.-Com. A. D. Brown, U. S. N.

NAVAL EDUCATION. First Honorable Mention. By Lieut.-Com. C. F. Goodrich, U. S. N.

NAVAL EDUCATION. Second Honorable Mention. By Commander A. T. Mahan, U. S. N.

1880.

"The Naval Policy of the United States." Prize Essay, 1880. By Lieutenant Charles Belknap, U. S. N.

1881.

The Type of (I) Armored Vessel, (II) Cruiser best suited to the Present Needs of the United States. Prize Essay, 1881. By Lieutenant E. W. Very, U. S. N.

SECOND PRIZE ESSAY, 1881. By Lieutenant Seaton Schroeder, U. S. N.

1882.

Our Merchant Marine: The Causes of its Decline and the Means to be taken for its Revival. "Nil clarius aquis." Prize Essay, 1882. By Lieutenant J. D. J. Kelley, U. S. N.

"MAIS IL FAUT CULTIVER NOTRE JARDIN." Honorable Mention. By Master C. G. Calkins, U. S. N.

"SPERO MELIORA." Honorable Mention. By Lieut.-Com. F. F. Chadwick, U. S. N.

"CAUSA LATET: VIS EST NOTISSIMA." Honorable Mention. By Lieutenant R. Wainwright, U. S. N.

1883.

How may the Sphere of Usefulness of Naval Officers be extended in Time of Peace with Advantage to the Country and the Naval Service? "Pour encourager les Autres." Prize Essay, 1883. By Lieutenant Carlos G. Calkins, U. S. N.

"SEMPER PARATUS." First Honorable Mention. By Commander N. H. Farquhar, U. S. N.

"CUILIBET IN ARTE SUA CREDENDUM EST." Second Honorable Mention. By Captain A. P. Cooke, U. S. N.

1884.

The Reconstruction and Increase of the Navy. Prize Essay, 1884. By Ensign W. I. Chambers, U. S. N.

1885.

Inducements for Retaining Trained Seamen in the Navy, and Best System of Rewards for Long and Faithful Service. Prize Essay, 1885. By Commander N. H. Farquhar, U. S. N.

1886.

What Changes in Organization and Drill are Necessary to Sail and Fight Effectively Our Warships of Latest Type? "Scire quod nescias." Prize Essay, 1886. By Lieutenant Carlos G. Calkins, U. S. N.

THE RESULT OF ALL NAVAL ADMINISTRATION AND EFFORTS FINDS ITS EXPRESSION IN GOOD ORGANIZATION AND THOROUGH DRILL ON BOARD OF SUITABLE SHIPS. Honorable Mention. By Ensign W. L. Rodgers, U. S. N.

1887.

The Naval Brigade: its Organization, Equipment and Tactics. "In hoc signo vinces." Prize Essay, 1887. By Lieutenant C. T. Hutchins.

1888.

Torpedoes. Prize Essay, 1888. By Lieut.-Com. W. W. Reisinger, U. S. N.

1891.

The Enlistment, Training and Organization of Crews for our Ships of War. Prize Essay, 1891. By Ensign A. P. Niblack, U. S. N.

DISPOSITION AND EMPLOYMENT OF THE FLEET: SHIP AND SQUADRON DRILL. Honorable Mention, 1891. By Lieutenant R. C. Smith, U. S. N.

1892.

Torpedo-boats: their Organization and Conduct. Prize Essay, 1892. By Wm. Laird Clowes.

1894.

The U.S.S. Vesuvius, with Special Reference to her Pneumatic Battery. Prize Essay, 1894. By Lieut.-Com. Seaton Schroeder, U. S. N.

NAVAL REFORM. Honorable Mention, 1894. By Passed Assistant Engineer F. M. Bennett, U. S. N.

1895.

Tactical Problems in Naval Warfare. Prize Essay, 1895. By Lieut.-Com. Richard Wainwright, U. S. N.

A SUMMARY OF THE SITUATION AND OUTLOOK IN EUROPE. An Introduction to the Study of Coming War. Honorable Mention, 1895. By Richmond Pearson Hobson, Assistant Naval Constructor, U. S. N.

SUGGESTIONS FOR INCREASING THE EFFICIENCY OF OUR NEW SHIPS. Honorable Mention, 1895. By Naval Constructor Wm. J. Baxter, U. S. N.

THE BATTLE OF THE YALU. Honorable Mention, 1895. By Ensign Frank Marble, U. S. N.

1896.

The Tactics of Ships in the Line of Battle. Prize Essay, 1896. By Lieutenant A. P. Niblack, U. S. N.

THE ORGANIZATION, TRAINING AND DISCIPLINE OF THE NAVY PERSONNEL AS VIEWED FROM THE SHIP. Honorable Mention, 1896. By Lieutenant Wm. F. Fullam, U. S. N.

NAVAL APPRENTICES, INDUCEMENTS, ENLISTING AND TRAINING. The Seaman Branch of the Navy. Honorable Mention, 1896. By Ensign Ryland D. Tisdale, U. S. N.

THE COMPOSITION OF THE FLEET. Honorable Mention, 1896. By Lieutenant John M. Ellicott, U. S. N.

1897.

Torpedo-boat Policy. Prize Essay, 1897. By Lieutenant R. C. Smith, U. S. N.

A PROPOSED UNIFORM COURSE OF INSTRUCTION FOR THE NAVAL MILITIA. Honorable Mention, 1897. By H. G. Dohrman, Associate Member, U. S. N. I.

TORPEDOES IN EXERCISE AND BATTLE. Honorable Mention, 1897. By Lieutenant J. M. Ellicott, U. S. N.

1898.

Esprit de Corps: A Tract for the Times. Prize Essay, 1898. By Captain Caspar Frederick Goodrich, U. S. N.

OUR NAVAL POWER. Honorable Mention, 1898. By Lieut.-Com. Richard Wainwright, U. S. N.

TARGET PRACTICE AND THE TRAINING OF GUN CAPTAINS. Honorable Mention, 1898. By Ensign R. H. Jackson, U. S. N.

1900.

Torpedo Craft: Types and Employment. Prize Essay, 1900. By Lieutenant R. H. Jackson, U. S. N.

THE AUTOMOBILE TORPEDO AND ITS USES. Honorable Mention, 1900. By Lieutenant L. H. Chandler, U. S. N.

1901.

Naval Administration and Organization. Prize Essay, 1901. By Lieutenant John Hood, U. S. N.

1903.

Gunnery in Our Navy. The Causes of its Inferiority and Their Remedies. Prize Essay, 1903. By Professor Philip R. Alger, U. S. N.

A NAVAL TRAINING POLICY AND SYSTEM. Honorable Mention, 1903. By Lieutenant James H. Reid, U. S. N.

SYSTEMATIC TRAINING OF THE ENLISTED PERSONNEL OF THE NAVY. Honorable Mention, 1903. By Lieutenant C. L. Hussey, U. S. N.

OUR TORPEDO-BOAT FLOTILLA. The Training Needed to Insure its Efficiency. Honorable Mention, 1903. By Lieutenant E. L. Beach, U. S. N.

1904.

The Fleet and its Personnel. Prize Essay, 1904. By Lieutenant S. P. Fullinwider, U. S. N.

A PLEA FOR A HIGHER PHYSICAL, MORAL, AND INTELLECTUAL STANDARD OF THE PERSONNEL FOR THE NAVY. Honorable Mention, 1904. By Medical Inspector Howard E. Ames, U. S. N.

1905.

American Naval Policy. Prize Essay, 1905. By Commander Bradley A. Fiske, U. S. N.

THE DEPARTMENT OF THE NAVY. Honorable Mention, 1905. By Rear-Admiral Stephen B. Luce, U. S. N.

1906.

Promotion by Selection. Prize Essay, 1906. By Commander Hawley O. Rittenhouse, U. S. N.

THE ELEMENTS OF FLEET TACTICS. First Honorable Mention, 1906. By Lieut.-Com. A. P. Niblack, U. S. N.

GLEANINGS FROM THE SEA OF JAPAN. Second Honorable Mention, 1906. By Captain Seaton Schroeder, U. S. N.

THE PURCHASE SYSTEM OF THE NAVY. Third Honorable Mention, 1906. By Pay Inspector J. A. Mudd, U. S. N.

1907.

Storekeeping at the Navy Yards. Prize Essay, 1907. By Pay Inspector John A. Mudd, U. S. N.

BATTLE REHEARSALS. A few thoughts on our next step in Fleet-Gunnery. First Honorable Mention, 1907. By Lieut.-Comdr. Yates Stirling, U. S. N.

THE NAVAL PROFESSION. Second Honorable Mention, 1907. By Commander Bradley A. Fiske, U. S. N.

1908.

A Few Hints to the Study of Naval Tactics. Prize Essay, 1908. By Lieutenant W. S. Pye, U. S. N.

THE MONEY FOR THE NAVY. First Honorable Mention, 1908. By Pay Inspector John A. Mudd, U. S. N.

THE NATION'S DEFENSE—THE OFFENSIVE FLEET. How Shall We Prepare It for Battle. Second Honorable Mention, 1908. By Lieut.-Commander Yates Stirling, U. S. N.

1909.

Some Ideas about Organization on Board Ship. Prize Essay, 1909. By Lieutenant Ernest J. King, U. S. N.

THE REORGANIZATION OF THE NAVAL ESTABLISHMENT. Honorable Mention, 1909. By Pay Inspector J. A. Mudd, U. S. N.

A PLEA FOR PHYSICAL TRAINING IN THE NAVY. Honorable Mention, 1909. By Commander A. P. Niblack, U. S. N.

THE NAVY AND COAST DEFENCE. Honorable Mention, 1909. By Commodore W. H. Beehler, U. S. N.

SPECIAL NOTICE.

NAVAL INSTITUTE PRIZE ESSAY, 1910.

A prize of two hundred dollars, with a gold medal, and a life-membership in the Institute, is offered by the Naval Institute for the best essay presented on any subject pertaining to the naval profession, subject to the following rules:

1. The award for the prize shall be made by the Board of Control, voting by ballot and without knowledge of the names of the competitors.

2. Each competitor to send his essay in a sealed envelope to the Secretary and Treasurer on or before January 1, 1910. The name of the writer shall not be given in this envelope, but instead thereof a motto. Accompanying the essay a separate sealed envelope will be sent to the Secretary and Treasurer, with the motto on the outside and writer's name and motto inside. This envelope is not to be opened until after the decision of the Board.

3. The successful essay to be published in the Proceedings of the Institute; and the essays of other competitors, receiving honorable mention, to be published also, at the discretion of the Board of Control; and no change shall be made in the text of any competitive essay, published in the Proceedings of the Institute, after it leaves the hands of the Board.

4. If, in the opinion of the Board of Control, the best essay presented is not of sufficient merit to be awarded the prize, it may receive "Honorable Mention" or such other distinction as the Board may decide.

5. In case one or more essays receive "Honorable Mention," the writer of the first of them in order of merit will receive seventy-five dollars and a life-membership in the Institute.

6. Any essay not having received honorable mention, may be published also, at the discretion of the Board of Control, but only with the consent of the author.

7. The essay is limited to fifty (50) printed pages of the Proceedings of the Institute.

8. All essays submitted must be either typewritten or copied in a clear and legible hand.

9. In the event of the prize being awarded to the winner of a previous year, a gold clasp, suitably engraved, will be given in lieu of the gold medal.

By direction of the Board of Control.

PHILIP R. ALGER,
Professor, U. S. N., Secretary and Treasurer.

NOTICE.

The U. S. Naval Institute was established in 1873, having for its object the advancement of professional and scientific knowledge in the Navy. It now enters upon its thirty-fifth year of existence, trusting as heretofore for its support to the officers and friends of the Navy. The members of the Board of Control cordially invite the co-operation and aid of their brother officers and others interested in the Navy, in furtherance of the aims of the Institute, by the contribution of papers and communications upon subjects of interest to the naval profession, as well as by personal support and influence.

On the subject of membership the Constitution reads as follows:

ARTICLE VII.

Sec. 1. The Institute shall consist of regular, life, honorary, and associate members.

Sec. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fee to the Secretary and Treasurer. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

Sec. 3. The Prize Essayist of each year shall be a life member without payment of fee.

Sec. 4. Honorary members shall be selected from distinguished Naval and Military Officers, and from eminent men of learning in civil life. The Secretary of the Navy shall be, *ex officio*, an honorary member. Their number shall not exceed thirty (30). Nominations for honorary members must be favorably reported by the Board of Control, and a vote equal to one-half the number of regular and life-members, given by proxy or presence, shall be cast, a majority electing.

Sec. 5. Associate members shall be elected from Officers of the Army, Revenue Cutter Service, foreign officers of the Naval and Military professions, and from persons in civil life who may be interested in the purposes of the Institute.

Sec. 6. Those entitled to become associate members may be elected life members, provided that the number not officially connected with the Navy and Marine Corps shall not at any time exceed one hundred (100).

Sec. 7. Associate members and life members, other than those entitled to regular membership, shall be elected as follows: "Nominations shall be made in writing to the Secretary and Treasurer, with the name of the member making them, and such nominations shall be submitted to the Board of Control, and, if their report be favorable, the Secretary and Treasurer shall make known the result at the next meeting of the Institute, and a vote shall then be taken, a majority of votes cast by members present electing."

The Proceedings are published quarterly, and may be obtained by non-members upon application to the Secretary and Treasurer at Annapolis, Md. Inventors of articles connected with the naval profession will be afforded an opportunity of exhibiting and explaining their inventions. A description of such inventions as may be deemed by the Board of Control of use to the service will be published in the Proceedings.

Single copies of the Proceedings, $1.00. Back numbers and complete sets can be obtained by applying to the Secretary and Treasurer, Annapolis, Md.

Annual subscriptions for non-members, $3.50. Annual dues for members and associate members, $3.00. Life members fee, $30.00.

All letters should be addressed U. S. Naval Institute, Annapolis, Md., and all checks, drafts, and money orders should be made payable to the same.